Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MARCH 6, 1919.

THE LIFE-WORK OF A HINDU CHEMIST.

Essays and Discourses. By Sir Prafulla Chandra Râу. With a Biographical Sketch and a Portrait. Pp. xxxii+349. (Madras: G. A. Natesan and Co., 1918.) Price 3 rupees.

SIR PRAFULLA CHANDRA RÂY, professor of chemistry in the Presidency College, Calcutta, is well known to chemists in this country as the author, either alone or in collaboration with his pupils, of more than a hundred papers, chiefly on the inorganic and organic nitrites, published in the Transactions of the Chemical Society, in Continental journals, or in the Journal of the Asiatic Society of Bengal. In his own country he is also known as the founder of a successful chemical industry, which, from small beginnings, now occupies factories spreading over an area of eight acres. It is one of the most successful concerns in India, and proved of considerable service to the Government during the war, when the supply of Western chemicals and drugs was seriously interfered with. It is entirely staffed with Bengali workers, and its research chemists are of its creator's training.

Naturally, such a man has had a great influence in India. He has succeeded in founding a school of native chemists capable of attacking and elucidating modern scientific problems. He has roused and quickened the Bengali brain from the torpor which had overtaken it, and by his example and precept has proved that the Hindu only needs training, encouragement, and direction to revive the ancient glories of his race in philosophy and science. The success of the commercial undertaking which he initiated also indicates that the Bengali is not lacking in the power of organisation, application, and steadfastness of purpose needed to conduct successfully a business enterprise.

It was to be expected, therefore, that Sir P. Chandra Râу should, as he expressed it, sooner or later find himself "the property of anybody and everybody," and be called upon by various educational institutions, by conferences, and by the periodical Press and leading newspapers interested in the social reform and development of the industrial and political life of India to address his countrymen on subjects which so closely affect their national welfare and prosperity; and it was equally certain that a demand should arise that these essays and discourses should be collected and published in some permanent form.

The little book before us is the outcome of this demand. It contains a series of addresses and articles on scientific education in India; on the pursuit and progress of chemistry in Bengal; on science in the vernacular literature; on the antiquity of Hindu chemistry; on the Educational Service of India; on the Bengali brain and its misuse; on Government and Indian industries, together with a number of appreciations of men who have signalised themselves in the national evolution of India.

The collection is prefaced by a short biographical sketch of the author, and concludes with a list of original contributions from the Indian School of Chemistry.

Such a book, as a literary production, cannot be judged wholly from a Western point of view. To do justice to it one must have some knowledge of, and sympathy with, the Oriental mind. Its language is at times suffused with a glow characteristic of the East, and its excessive eulogy and altisonant phrases, as Evelyn would have styled them, are apt to provoke a smile in the stolid and more cold-blooded Englishman. At the same time, it is impossible not to recognise and appreciate the earnestness, courage, and sense of duty of the author, or fail to perceive his sincerity or the strength of his convictions in warring against the galling restrictions of caste, of social inequalities and depression, which are at the bottom of India's degradation. Her elevation will not come in Sir P. Chandra Râу's time. A small, spare man, in feeble health, and a con-

firmed dyspeptic, he will be spent in her service. But the memory of these services will survive, and the little book to which we direct attention will serve to perpetuate it.

T. E. Thorpe.

GRAVITATION AND RELATIVITY.

The Physical Society of London. Report on the Relativity Theory of Gravitation. By Prof. A. S. Eddington. Pp. vii+91. (London: Fleetway Press, Ltd., 1918.) Price 6s. net.

In the year 1905 a paper was published by Dr. A. Einstein which gave to the world of physical science a new subject for controversy under the title of "The Principle of Relativity." For ten years discussion reigned between those who held to the æther as a firm basis to the universe, and those who, treading more mathematically, felt a safer foothold on Einstein's elegant abstraction, little caring that æther, space, and time all trembled.

While men talked, the author of the disturbance was quietly preparing a greater. His first effort had left to the materialist a little comfort and cause for self-conceit in that it had not succeeded in resolving the old contradiction between a metaphysical theory of the relativity of space and time and the apparent existence of an absolute standard of rotational motion. The new theory, however, claims, not only that the complete relativity of space and time is true to the facts, but also that it can throw light on gravitational phenomena which was not shed by the more limited principle. To quote the author of this report: *"Einstein's theory has been successful in explaining the celebrated astronomical discordance of the motion of the perihelion of Mercury without introducing any arbitrary constant; there is no trace of forced agreement about this prediction."*

Any theory of gravitation which succeeded in doing this would be worthy of serious consideration, but what words should be applied to one which transcends the limitations of Newton's marvellous achievement through the acceptance of the doctrine of complete relativity of space and time?

In the earlier theory the one essential constant and invariant magnitude was the velocity of light (c). In mathematical signs, $dx^2+dy^2+dz^2-c^2dt^2$ was invariant. It is obvious that this cannot be so for a complete relativity, but a general quadratic expression in dx, dy, dz, dt will remain through all changes an expression of the same type, though the coefficients of the several terms will be functions of position and time instead of constants. In the new theory it is assumed that the physical properties of space are such that there is a quadratic form of this kind which remains invariant. The physical state at any point and instant is summarised in the values of the coefficients. It is Einstein's achievement to have been able to apply the work of the pure mathematician to find equations between these quantities which, while reducing to the equations of Newtonian gravitation for all frames of reference to which the old principle of relativity applies, have a completely invariant form.

While we wonder at the feat, and at the vision of a hitherto uncomprehended unity of thought, there remain some obstinate questionings. If this dream of complete relativity be true we are getting near the point at which it is so general as to lose touch with common experience. The new law of gravitation has not that astounding simplicity of expression which distinguishes that of Newton. The old problem of absolute rotation is thrown further back; but it remains true that there are systems of reference for which dynamical phenomena present their greatest simplicity. We ask why our first naive choice of a system of measurement ready to hand is such that within it material bodies have a nearly permanent configuration, and light has an approximately constant velocity.

Generalisation is the supreme intellectual achievement, but it may leave us thirsting for the particular and for simplicity. This report on what may be the most remarkable publication during the war leaves us wondering in which direction the greater satisfaction is given.

OUR BOOKSHELF.

Mnemonic Notation for Engineering Formulae. Report of the Science Committee of the Concrete Institute. With explanatory notes by E. F. Etchells. Pp. 116. (London: E. and F. N. Spon, Ltd., 1918.) Price 6s. net.

This book contains a series of miscellaneous papers dealing with the application of mnemonic notation to various branches of pure and applied science, and especially to structural engineering. The formulæ of science should not be expressed in misleading symbols which are not suggestive of the quantities concerned, but in a notation which is the "embodiment of organised common sense." The key to the notation adopted is to be found in the abbreviation of the significant words in any term until only the initial letter remains. In a few instances the second, or even the final, letter may be retained to form a subscript to the initial letter. "The *greater* letters are used to indicate *greaterness* of quantity or *greaterness* of complexity."

There is no doubt that the scheme proposed is founded on sound principles, which have been long recognised by competent teachers. To some it may seem that in parts of the present volume there is a tendency to elaborate the obvious, and that the report would have been more convincing if there had been fewer repetitions and less frequent use of odd and unfamiliar language. A series of useful appendices dealing with various practical questions, such as calculations for business purposes and the printing of mathematical formulæ, occupies more than two-thirds of the book.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1919. Edited by George E. Brown. Pp. 644. (London: Henry Greenwood and Co., Ltd., 1918.) Price 1*s*. 6*d*. net.

It is very satisfactory that this annual has survived the war, for it is indispensable wherever photography other than mere routine work is actively carried on. The present volume is the fifth issued since August, 1914, and suffers the most severely of all from the restrictions that necessity has imposed upon us. However, even this is a substantial volume, in which none of the main features that we have been led to expect are omitted. The article by the editor is on "Photographic Definitions," and these are arranged according to subject in a series of sections, each of which is a kind of running commentary on the subject of its title. The commercial uncertainty of the present time is shown by the comparatively few prices that are given in the advertisements. The most useful section to the student, the "Epitome of Progress," shows that notable advances have been made in the science of photography, as well as in the prices of materials. We regret that formulæ for the use of metol and glycin as developers are not given. Metol, certainly, is as generally useful as ever it was. Perhaps these were removed because of their "enemy origin," but they have for some time been "British-made," and figure in at least two or three places in the advertisement pages.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Directorship of the Natural History Museum.

THE Director of the British Museum (Natural History) is about to retire, and we learn with deep apprehension that the principal trustees, with whom the appointment rests, have received, or are about to receive, from the general body of trustees a recommendation to pass over the claims of scientific men and to appoint a lay official, who is at present assistant secretary. The former directors, Sir Richard Owen, Sir William Flower, and Sir Ray Lankester, like the present director, Sir Lazarus Fletcher, were all distinguished scientific men. The Natural History Museum is a scientific institution. There is a large staff of scientific keepers and assistants. The director has to represent natural history to the public, to other scientific institutions at home, in the Dominions and Colonies, and in foreign countries, and to the many Government Departments with which the museum has relations. He must represent it with knowledge and authority. There are few posts with such possibilities of advancing the natural history sciences, of making them useful to the nation, and of interpreting them to the public. The existence of the post is a great stimulus to the zeal and ambition of zoologists and geologists.

The arguments alleged in favour of the recommendation are trivial. It is stated that a former director was allowed by the trustees to leave the administrative details to the member of the clerical staff whom it is proposed to promote, that he performed these duties with ability, and during the tenure of the present director retained and extended his powers. It is urged that the tenure of the new director would be short, as he would have to retire in two years under the age limit. It is pleaded that promotion would entitle him to a larger pension, and that he need not be called director, but only acting-director.

Plainly, if the assistant secretary be the only man who knows the details of administration, it is important that the permanent director should be appointed at once, in order to have the opportunity of learning them before taking them over. In actual fact there is nothing in the administrative work of the directorship that could not be learned in a few weeks or months by any person of ordinary intelligence. At least two of the present keepers are eligible for the vacancy, have attained the necessary scientific standing, and have ample experience of the museum itself. To pass over these or several eminent and eligible men not on the staff in favour of one of the ordinary office staff would be an affront to scientific men and of grave detriment to science.

W. BOYD DAWKINS, F.R.S. (Honorary Professor of Geology and Palæontology, Manchester).
J. COSSAR EWART, F.R.S. (Professor of Natural History, Edinburgh).
F. W. GAMBLE, F.R.S. (Professor of Zoology, Birmingham).
J. S. GARDINER, F.R.S. (Professor of Zoology, Cambridge).
WALTER GARSTANG, D.Sc. (Professor of Zoology, Leeds).
E. S. GOODRICH, F.R.S. (Aldrichian Demonstrator of Comparative Anatomy, Oxford).
W. A. HERDMAN, F.R.S. (Foreign Secretary, Royal Society, Professor of Natural History, Liverpool).
S. J. HICKSON, F.R.S. (Professor of Zoology, Manchester).
J. P. HILL, F.R.S. (Jodrell Professor of Zoology, London).
W. E. HOYLE, D.Sc. (Director, National Museum of Wales).
ARTHUR KEITH, F.R.S. (Hunterian Professor and Conservator of the Museum of the Royal College of Surgeons).
J. GRAHAM KERR, F.R.S. (Regius Professor of Zoology, Glasgow).
E. W. MACBRIDE, F.R.S. (Professor of Zoology, Imperial College of Science).
W. C. McINTOSH, F.R.S. (Emeritus Professor of Natural History, St. Andrews).
J. E. MARR, F.R.S. (Woodwardian Professor of Geology, Cambridge).
P. CHALMERS MITCHELL, C.B.E., F.R.S. (Secretary, Zoological Society of London).
E. B. POULTON, F.R.S. (Hope Professor of Zoology, Oxford).
R. C. PUNNETT, F.R.S. (Arthur Balfour Professor of Genetics, Cambridge).
A. C. SEWARD, F.R.S. (Master of Downing College, and Professor of Botany, Cambridge).
A. E. SHIPLEY, F.R.S. (Master of Christ's College and Reader of Zoology, Cambridge).
W. J. SOLLAS, F.R.S. (Professor of Geology, Oxford).
JETHRO J. H. TEALL, F.R.S. (lately Director of the Geological Survey of Great Britain).
J. ARTHUR THOMSON, LL.D. (Professor of Natural History, Aberdeen).

February 27.

The Supposed "Fascination" of Birds.

It is well known that the stoat (*Putorius ermineus*) sometimes performs extravagant antics by way of ruse in approaching rabbits or small birds, which, in the opinion of some persons, are "fascinated" or hypnotised by the display. I incline to believe that the subject of these manœuvres becomes so deeply interested, amused, or puzzled by the movements of the acrobat that it defers flight until too late. This view has been strengthened by what I witnessed from my library window in the spring of 1917. A male blackbird was sitting on the open lawn; a stoat was racing round the bird at high speed, now rolling itself into a ball, racing again, then leaping fully 2 ft. high and turning an aerial somersault, and again racing in circles. How long the performance had been going on before I happened to become a spectator I know not, but it went on under my eyes for perhaps seven minutes, during which time the blackbird never stirred and the stoat continued in violent movement. Every moment I expected that it would spring upon the bird, which it might easily have done, but nothing of the kind happened. Suddenly, in the middle of the performance, the blackbird flew away; and the stoat, apparently not caring to exhibit without a "gallery," resumed its normal gait and disappeared in the bushes.

Now if the blackbird was "fascinated" in the sense of an arrest of motor volition, what broke the spell? The acrobat was at the height of its antics when the bird flew off. One may assume, I think, that the latter's interest in the performance was absorbing up to a certain point, for it is contrary to the habits of a blackbird to sit motionless for many minutes on a spring morning; but it does not seem as if its volition had been affected.

In his great work on British mammals Mr. J. G. Millais describes instances of the stoat (than which there is no more bloodthirsty animal) resorting to these acrobatic feats with no deadly purpose, finishing up by romping with its audience of young rabbits and worrying them in make-believe. In the case I have described it does not appear that the stoat had any intention of making its breakfast off the blackbird.

HERBERT MAXWELL.

Monreith, Whauphill, Wigtownshire, N.B.

Girvanella and the Foraminifera.

BULLETIN No. 104 of the United States National Museum contains the first part of Mr. J. A. Cushman's "Foraminifera of the Atlantic Ocean." Workers in this group will find it of much value to have a complete and well-illustrated account of the foraminifera as occurring in the Atlantic. In this paper there is, however, one doubtful point in regard to affinity in which two distinct organisms are confused, and this, if not corrected, will mislead the student. I refer to the relegation of Brady's *Hyperammina vagans* to the genus Girvanella, Nicholson and Etheridge. It is a generally accepted opinion that Girvanella is probably related to the blue-green algæ (Cyanophyceæ), as shown by Rothpletz, Wethered, Seward, Garwood, and the writer. In the earliest descriptions Nicholson and Etheridge, it is true, held Girvanella to be of foraminiferal affinities, and Brady compared it to *H. vagans*, but the consensus of opinion is now in favour of its plant origin. As I have elsewhere shown (Aust. Assoc. Adv. Sci., Adelaide, 1907), its larger dimensions, arenaceous shell-wall, bulbous primordial chamber, simple, not branching, tube, and absence of septation separate it from Girvanella. In following Rhumbler (1913), Cushman includes other species of thread-like rambling and attached organisms. Whether they are all foraminiferal or algal in affinities can be determined only by careful examination by means of microscope sections, at the same time bearing in mind that the structure of the true Girvanella tube is not a mosaic of particles held by cement, but a finely granular structure such as is seen in other living calcareous algæ. The point here raised is directed against the placing of the genus Girvanella, as defined by Nicholson and Etheridge, with the Foraminifera.

FREDK. CHAPMAN.

National Museum, Melbourne,
December 23, 1918.

Feeding Habits of Nestling Bee-eaters.

THE paragraph in NATURE of March 28, 1918, p. 70, upon a paper in which Mr. W. Rowan describes the defæcation of the nestlings of the British kingfisher, leads me to mention the habits of a bird also nesting in tunnels. I refer to the bee-eater (Merops). Mr. J. E. Ward, recently a fellow-passenger from New Guinea, told me that the young of a Papuan species defæcate outside the nest but within the tunnel. The fæces attract flies, which breed in the mass, and the resulting larvæ form the food of the very young nestlings. As the flies later emerge, the young birds have grown sufficiently to be able to catch the insects on the wing.

Mr. Ward noticed that nestlings in captivity did not gape for food as do most young birds, and he was thus led to investigate the subject, with the result above mentioned.

EDGAR R. WAITE.

S.A. Museum, Adelaide, September 6, 1918.

THE COMMERCIAL USE OF AIRSHIPS.

THE future of the rigid airship from the commercial point of view is brought prominently into notice by a paper lately issued by the Air Ministry entitled "Notes on Airships for Commercial Purposes." This memorandum discusses at length the possibility of the use of airships in the immediate future, and enters into a detailed comparison between the large aeroplane and the rigid airship. At the outset it is stated, however, that the two types of aircraft, as at present developed, are not likely to compete with one another seriously, since their characteristics are widely different, the aeroplane being essentially a high-speed, short-distance machine, while the rigid airship is a long-distance, weight-carrying craft. The great endurance of the airship and its power of remaining in the air during a temporary breakdown of the machinery are valuable assets when long flights over sea or mountainous country are contemplated. The safety and comfort of passengers are considered to be greater in the case of the airship than in that of the aeroplane. In connection with the possibility of loss by fire in the former case the Air Ministry points out that there has been only one such loss since 1914, despite the fact that about 2½ million miles have been covered, and that in this one case the cause of fire has been ascertained and eliminated. It is conceded that at present the airship is more affected by bad weather than the aeroplane, but it is stated

that up to the end of November there were only nine days in 1918 on which no airship flight took place in the British Isles.

Having thus indicated the suitability of the airship for commercial purposes, the paper goes on to discuss the developments which have taken place during the last four years in the design of both airships and aeroplanes, and it is considered that the development of the airship has been even more marked than that of the aeroplane when regarded from the point of view of weight-carrying. Considerable emphasis is laid on the fact that for a given increase in the gross weight of an aeroplane a more than proportional increase is necessary in the weight of the structure itself if the same factor of safety is to be maintained; whereas in the case of the airship the strength of the structure is maintained if the structural weight is directly proportional to the gross weight. This difference is explained by the fact that the lift of similar aeroplanes is proportional to the square of their linear dimensions, whereas the lift of similar airships varies as the cube of the dimensions. If, therefore, the size of aeroplanes is increased very greatly, while still adhering to the present materials and constructional methods, a point would be reached where the machine could only just lift its own weight, with no reserve for carrying useful load. With the airship, however, the useful load increases continuously, no matter how large the ship.

It therefore appears that, while airships of great carrying capacity are theoretically possible on the present lines of design, it is impossible to build aeroplanes to carry anything like the same loads unless methods of design can be radically altered. A comparison of this kind is not necessarily an argument in favour of the airship, as it may be ultimately found better to carry a given load by a number of aeroplanes of reasonable dimensions rather than by a single huge airship.

Numerical illustrations are given of the improvement since 1914 in the cases of aeroplanes and rigid airships, and a rough indication of the results arrived at is given in the table below:—

Type of aircraft	Speed (miles per hour)	Horse-power	Useful load (tons)
1914 Avro	70	80	0·27
1918 D.H. 10A	125	810	1·45
1914 Zeppelin (average) ...	50	800	8·5
1918 Zeppelin (L.70) ...	78	2100	38·8
Proposed 10,000,000 cu. ft. rigid airship	86	6000	170

The table shows the possibilities of the airship as a weight-carrier in a marked manner, but it is somewhat difficult to make a comparison of merit when the size and the speed of flight are so variable for the various aircraft. If it be assumed that the horse-power varies as the cube of the speed (an assumption which is true for the airship, and approximately correct for the aeroplane), it is possible to compare roughly the performances by noting the value of $\frac{WV^3}{\text{horse-power}}$ for the various craft, where W is the useful load in tons, and V the speed in miles per hour. For the five machines above considered, the values are:—

1914 Avro	1,100
1918 D.H. 10A	3,300
1914 Zeppelin	1,300
1918 L.70	8,200
10,000,000 cu. ft. rigid ...	18,000

These figures indicate clearly that, from the point of view of fuel consumption, the large airship is much more efficient than the aeroplane for carrying great loads at a moderate speed. It is possible, however, that this superiority may in practice be outweighed by the greater cost of upkeep of the airship, and, in particular, by the cost of the large housing sheds which are at present necessary, with their attendant need of a large *personnel* to handle the ships. The aeroplane will, of course, always be the better machine where small loads are to be carried at the highest possible speeds, and it is quite likely that a combination of aeroplane and airship services will often prove the best practical solution. For instance, as suggested in the paper under discussion, a rigid airship service might run between Lisbon and New York, passengers being taken to Lisbon from Paris, Rome, etc., by aeroplane. The aeroplane would thus compete with the express train, and the airship with the ocean liner, and a gain of not less than 50 per cent. in the time of transit would be realised in both cases.

In conclusion, the Air Ministry appears very optimistic as to the possibilities of the rigid airship in commerce, and produces excellent reasoning to support its optimism. One note of warning is sounded, and cannot be sounded too often, namely, that progress in point of size of aircraft must be made gradually. A premature attempt to build a very large aeroplane or airship is doomed to failure, and would do much to prejudice future development. If, however, progress is attempted in easy stages, giving time to overcome difficulties gradually, and to apply experience so gained to the next stage of development, there is every reason to hope that vast improvement will result in both aeroplanes and airships, and that the success of commercial aviation will be assured.

DR. F. DU CANE GODMAN, F.R.S.

THE death of Dr. Frederick Du Cane Godman on February 19 removes a familiar figure from the meetings of our scientific societies. Few men had greater opportunities of benefiting the science of their choice; none made a better use of them.

There is something characteristically British in the development of Godman's life-work out of the associations and friendships of his student days at the university. For it was at Cambridge in Godman's time and with Godman's help that the Ornithological Union and its journal, the *Ibis*, were founded, and at Cambridge that his fruitful friendship with Osbert Salvin was begun. Of that friendship, which closed with the death of Salvin in 1898, he wrote in his introduction to

the "Biologia Centrali-Americana": "The severance of a friendship such as ours had been for forty-four years was a terrible blow to me, for we were more intimately connected than most brothers, and, besides the personal loss, I missed his knowledge and experience in all things connected with our book. . . . It was with a heavy heart that I took up my pen again."

The choice of Central America as the field for their great enterprise was determined by an accident—the search for commercially profitable palm-nuts by Salvin in 1857—but no accident could have been more fortunate, for it hit upon the most interesting and exciting of all links between the tropics and the great northern land-belt. Prolonged isolation has led to the development, upon the great continent to the south, of a fauna unequalled in the world for combined peculiarity and richness. Then, in the fullness of time, the area supporting this teeming and varied population lost its isolation. What more exciting problem than a study of the intermediate tract which would show how far the southern forms have pushed to the north, the northern to the south? We know, as the result of this study, that the boundary between the two areas is concave towards the north, for the lower temperature of the high central Mexican plateau favours the northern forms, while the heat of the lower slopes and flats on the two coasts favours the southern.

It is unnecessary, on the present occasion, to speak in any detail of the sixty-three quarto volumes and 1677 plates in which this splendid contribution to zoology, botany, and anthropology is contained, for an admirable and yet brief statement of the history and scope of the work will be found in Godman's introduction, published in 1916. But a word must be said of the great band of naturalists who gathered round and assisted the two editors. Of this band, some, like H. W. Bates, Albert Günther, Joseph Hooker, O. Pickard-Cambridge, and P. L. Sclater, were veterans in 1879, when the first part appeared, and are now great memories. Others, again, found in the "Biologia" the whole of their training, and nearly the whole of their experience, as systematists. It is as Godman and Salvin would have wished, that their memories should always be bound up with those of the great body of experts who laboured with them.

Godman was the most modest of men. He found his reward in his love of the work he had undertaken, and looked neither for honours nor for recognition; but when they came the evidence of appreciation by his scientific comrades was a great pleasure and encouragement to him.

Outside his own subject Godman took a keen interest in all that concerned the advancement of science, and its neglect in this country was a real grief to him. He saw clearly the double importance of science for its own sake and for the sake of the intellectual training it gives. In these essential things he felt strongly that the country was being starved, and he feared for the future when he thought of our politicians and the way they had accepted their responsibilities in the past.

In failing health at the end of his long life, Godman's interest and sympathy remained unclouded, and in his dying hours he sent a last message to his colleagues giving his opinion on a much-debated subject about which he felt strongly. His last thoughts were with the great National Museum to which he had made so many noble contributions. E. B. P.

NOTES.

THE following fifteen candidates were selected on Thursday last by the council of the Royal Society to be recommended for election into the society:—Prof. F. A. Bainbridge, Dr. G. Barger, Dr. S. Chapman, Sir C. F. Close, Dr. J. W. Evans, Sir Maurice Fitzmaurice, Dr. G. S. Graham-Smith, Mr. E. Heron-Allen, Dr. W. D. Matthew, Dr. C. G. Seligman, Prof. B. D. Steele, Major G. I. Taylor, Prof. G. N. Watson, Dr. J. C. Willis, and Prof. T. B. Wood.

SIR LAZARUS FLETCHER retired on March 3 from the directorship of the Natural History Museum after forty-one years in the service of the Trustees. Previous to his appointment as director on May 22, 1909, he had served two years as assistant and twenty-nine years as keeper in the Mineral Department. As keeper of minerals his first arduous task was to superintend the removal of the mineral collections from Bloomsbury to South Kensington, and to re-arrange them in the Natural History Museum. His next work was the preparation of those admirable guides, the introductions to the study of minerals, rocks, and meteorites respectively, and the selection and arrangement of series of specimens to illustrate them, which have earned him the gratitude of all students of the subject. "The Introduction to the Study of Minerals" is a highly successful attempt on the part of a great mathematician and chemist to surmount the difficulty of explaining a very technical subject without the aid of mathematics and chemical formulæ. In the intervals of this work, and later, Sir Lazarus Fletcher found time, in the chemical laboratory which had been fitted up in the museum, for his well-known researches on meteorites and minerals. After this exacting work as keeper of the Mineral Department, his tenure of office as director of the museum was still not devoid of care, for soon after his accession an attempted encroachment upon the grounds which had been allotted for the future expansion of the museum had to be repelled, and more recently during the war certain proposals which, if carried out, would have been disastrous to the collections had to be met.

A FEW weeks ago (January 23, p. 409) we referred to the approaching retirement of Sir Lazarus Fletcher from the directorship of the Natural History Museum, and the duty thus placed upon the Trustees of finding a successor who will maintain the high prestige of the museum among the corresponding institutions of the world From the letter which appears in our correspondence columns, signed by twenty-three naturalists of distinguished eminence, it appears that, as a temporary measure, the appointment of an administrative official to the post of director has been contemplated. We can scarcely believe that the Trustees will adopt such a course of action, which would be most derogatory to the position of science and the interests of the museum. The shortness of tenure, and the provision of an increased retiring

pension at the end, are merely matters of expediency, and are as nothing by the side of the principle and precedent involved. Scientific men should not for a moment accept the view that they are incapable of administration, or that the high posts which their knowledge qualifies them to fill can be occupied efficiently by administrators not possessing it. Skilled secretarial work, no doubt, facilitates communication between Government Departments, but it signifies routine and stagnation when it controls the activities of a scientific institution. Knowledge gives the driving power required for progressive development, and administrative functions should be subsidiary to it. Throughout the Civil Service there is already far too much of the reverse condition. We are glad, therefore, that a strong protest has been made against the assumption that the highest post open to naturalists in this country can be filled by an officer without the necessary scientific qualifications to do credit to it and the nation in the eyes of the world.

The facts made known by Lord Gainford and Lord Harcourt in the House of Lords on February 26 show that a long time must elapse before our museums and the staff of the Board of Education can resume their work unhindered. The latter body is scattered throughout London, while its records are stored in the galleries of the Victoria and Albert Museum. Half that museum is closed to the public, its circulation department shut down, its textile classes and other aids to industry suspended. The priceless Wallace collections are still in underground tubes. The National Portrait Gallery, the London Museum, the Tate Gallery, and the British Museum galleries of prints and of Egyptian and Assyrian antiquities, as well as much of its storage space, are occupied by huge clerical staffs. Finally, the exhibition galleries of the Imperial Institute continue to be filled with a succession of other Departments; the institute's lectures and demonstrations are in abeyance, and its own research work is hampered because the raw materials are stored elsewhere. The result is not only to disappoint the American and Dominion troops, and to deny the British taxpayer the enjoyment of his great educational establishments; it is, above all, a serious check on the commercial and industrial development of the country. Unavoidable the delay may be, yet we cannot help feeling that the situation would not have arisen had Ministers a truer appreciation of the work done by and in our public museums.

The King has consented to act as patron of the British Scientific Products Exhibition, 1919, which will be held at the Central Hall, Westminster, during the month of July. The president of the exhibition is the Marquess of Crewe, and the vice-presidents include the Prime Minister and all the leading members of the Government. Prof. R. A. Gregory is chairman of the organising committee. The British Science Guild has been encouraged to organise this exhibition by the success which attended that held at King's College last summer and the more recent exhibition at Manchester. Now that many inventions can be shown which could not be put before the public during the war, there is every prospect that this year's exhibition will be even more successful than its predecessors. The objects of the exhibition will be to illustrate recent progress in British science and invention, and to help the establishment and development of new British industries. Such an exhibition will enable new appliances and devices to be displayed before a large public, and will provide progressive manufacturers with an opportunity of examining inventions likely to be of service to them, thus serving as a kind of clearing-house for inventors and manufacturers, as well as illustrating developments in science and industry. The exhibition will include sections dealing with chemistry, metallurgy, physics, agriculture and foods, mechanical and electrical engineering, education, paper, illustration and typography, medicine and surgery, fuels, aircraft, and textiles. Firms desirous of exhibiting are invited to communicate with the organising secretary, Mr. F. S. Spiers, 82 Victoria Street, London, S.W.1.

At the forty-first annual general meeting of the Institute of Chemistry held on Monday, March 3, Sir Herbert Jackson, the president, referred to the work of the institute during the war. The record afforded an example of the value to the country of organised professional bodies in times of crisis. The institute is now co-operating with the Appointments Department of the Ministry of Labour in the resettlement in civil life of those who have been so engaged, and it is hoped that with the return of more normal conditions chemists will be utilised to the fullest advantage in the application of their science to the industries of the country. The president, in referring to the losses sustained by the profession, mentioned especially Lt.-Col. E. F. Harrison, who will always be remembered for his exceptional work in the provision of means of defence against poisonous gas attacks, in which work he undoubtedly sacrificed his life. The institute has before it a period of reconstruction, and will endeavour to bring together in one body the trained and competent chemists both for their own benefit and for that of the community. The events of the war have done much to establish the claim of chemists to greater recognition than has been accorded them in the past. The council has recently prepared a scheme of Government Chemical Service, which it is hoped will secure better conditions for chemists holding appointments under various Departments. The vital importance of chemical service to the State has been clearly demonstrated in recent years, and a good example set by the Government will go far to bring home to the public the importance of chemistry to industry and commerce. Sir Herbert Jackson was re-elected president of the institute for the ensuing year.

When the Ministry of Health Bill passed its second reading in the House of Commons on February 26 Major Astor, Parliamentary Secretary to the Local Government Board, who replied on the debate, expressed gratification that a first-class measure had practically secured unanimous support from all parts of the House. From all accounts this is exactly what happened, and, apart from certain of the Welsh members, who desire to see separate provision made for the Principality, and some of the Irish members who do, and some who do not, wish to see the proposed Bill extended to Ireland, there were few voices raised in criticism. Clearly the majority had come to the second reading convinced that the Bill was the best likely to be obtained, and prepared to support it and accept all it proposed in the way of transference of powers, consultative councils, etc. Dr. Addison's advocacy, sound though it was, apparently was also quite dispassionate. His attitude suggested that he was addressing the members of a learned society and engaged in reading a paper upon a scientific subject. This impression was heightened by the fact that a large proportion of those who took part in the debate were medical men. These, led by Sir Watson Cheyne, devoted themselves largely to the question of research and the provision in clause 3 for placing this most important work in the hands of the Privy Council. It is interesting to note that, not only inside the House,

but also outside, and particularly amongst medical officers of health, whose society has issued a memorandum dealing with the Bill, medical opinion is strongly against any Department other than the Ministry of Health having control of research. In regard to the failure of the Bill to provide for the taking over by the Ministry of lunacy and mental deficiency there was comment also, and here again medical opinion is in favour of transference. As Dr. Addison pointed out, however, there was much detail that must be left to the future. The main and pressing business of the moment is to get the Ministry formed and to see that the definite fundamental health matters are brought within its purview. Other things will follow when the Ministry and the Minister have shown themselves worthy of the trust which everybody seems to be so willing to give them and of the high hopes that are based upon them.

CAPT. G. P. THOMSON will deliver his postponed lecture on "The Dynamics of Flying" at the Royal Institution on Monday next, March 10, at 3 o'clock.

THE death is announced, at eighty-five years of age, of Dr. Robert Liveing, consulting physician to the skin department of the Middlesex Hospital, and formerly lecturer on anatomy at Middlesex Hospital.

WE regret to announce the death on February 8, at ninety-four years of age, of Prof. J. J. T. Schlœsing, doyen of the section of rural economy of the Paris Academy of Sciences, and professor of agricultural chemistry in the Paris Conservatoire des Arts et Métiers.

Science for February 7 announces that Major C. E. Mendenhall, professor of physics in the University of Wisconsin, has been appointed scientific attaché to the United States Legation in London, and has been given leave of absence from the University to take up the duties of this post immediately.

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 3, the following were elected ordinary fellows:—Dr. A. R. Cushny, Dr. W. J. Dundas, Dr. R. O. Morris, Dr. T. S. Patterson, Mr. B. D. Porritt, Mr. A. H. Roberts, Mr. W. A. Robertson, Dr. A. Scott, Dr. A. R. Scott, Mr. W. W. Smith, and Capt. D. A. Stevenson.

THE following lectures will be delivered at the Royal College of Physicians during March and April:—Milroy lectures, Half a Century of Smallpox and Vaccination, Dr. John C. McVail; Goulstonian lectures, The Spread of Bacterial Infection, Dr. W. W. C. Topley; Lumleian lectures, Cerebro-spinal Fever, Sir Humphry D. Rolleston.

THE Paris correspondent of the *Morning Post* announces the death, at sixty-eight years of age, of Prof. André Chantemesse, professor of hygiene in the faculty of medicine in Paris, member of the Academy of Medicine, and Inspector-General of Sanitary Services. Prof. Chantemesse was the author of works on typhoid fever, and others entitled "Moustiques et Fièvre Jaune," "Mouches et Choléra," and "Frontières et Prophylaxie."

AT a special general meeting of the British Psychological Society held in London on February 19 it was unanimously resolved that persons interested (instead of, as heretofore, engaged) in the various branches of psychology shall be eligible for membership. It was also decided to institute three special sections of the society, devoted respectively to the educational, industrial, and medical aspects of psychology. Further particulars may be obtained from the honorary secretary of the British Psychological Society, the Psychological Laboratory, University College, W.C.1.

IT is with regret we record that Capt. Melville Willis Campbell Hepworth, Marine Superintendent of the Meteorological Office, died at his residence at Ealing on February 25. Capt. Hepworth was in his seventieth year, and had held his official position since 1899. He was a Younger Brother of Trinity House, and received his C.B. in 1902 at the coronation of King Edward VII. The Monthly Meteorological Charts of the North Atlantic and Mediterranean, as well as of the East Indian seas, were initiated during his tenure of office, and the later editions of "The Barometer Manual for the Use of Seamen" and the "Seaman's Handbook of Meteorology" were compiled under his direction, and attained a large circulation. Capt. Hepworth was much interested in marine biology and in the temperature and salinity of the sea. Prior to his association with the Meteorological Office he was in command of mail steamers trading to the Cape and Australia, and later of vessels engaged on the Canadian-Australian steam route. For many years while at sea he made a study of meteorology which prepared him for his official position.

SIR ANDREW FRASER, K.C.S.I., whose death has recently been announced, was the son of a missionary and one of the many Scottish Presbyterians who have been distinguished members of the Indian Civil Service, and began his work in India in 1871. He served with distinction in the Central Provinces, and in 1903 was appointed Lieutenant-Governor of Bengal. He was in some ways unsuited for this difficult office, because he was unacquainted with the Bengali character, and was not qualified to deal with the organised resistance against the partition of the Provinces. While his policy of attempting to conciliate the revolutionary party, as is usual in India, served only to encourage anarchism, he met with courage at least five attempts against his life. Sir Andrew Fraser was a typical official of the secretariat type, and beyond his official duties his interests were limited, as is shown by the account of his experiences in his book "Among Indian Rajahs and Ryots," which, while interesting as a record of his official life, is lacking in first-hand knowledge of the ethnology, religions, customs, and manners of the races of India.

IT is reported from Ottawa that Mr. S. Storkerson, of the Canadian Arctic Expedition, with his party of five men, safely reached the Alaskan coast on November 19 last. When Mr. Stefansson was incapacitated by illness in December, 1917, and had to return to civilisation, his place was taken by Mr. Storkerson, who immediately made preparations for a journey from the coast of Alaska northward over the ice of the Beaufort Sea. He left Cross Island in about long. 146° W. on March 15, 1918, with a large party, including several Eskimo. When about two hundred miles north of the coast he sent back several of his men, and with the remainder continued his journey, expecting to be carried westward with the ice to the coast of Siberia. Practically no provisions were carried, the party relying on seal-meat and polar bears, as had been done in all the journeys of the Stefansson expedition. Contrary to expectations, based on the drift of the *Karluk* and other evidence, the ice did not move westward, but drifted around in a great eddy. The most northerly point reached was lat. 74° N., long. 152° W., in a part of the Arctic Ocean not previously explored. The problematical Keanan's

Land, which appeared in many maps in about lat. 74° N., long. 140° W., does not exist.

PROF. ANDREW MELVILLE PATERSON, who died after a brief illness on February 13 at the age of fifty-six, held a conspicuous place amongst modern British anatomists. Graduating in medicine at Edinburgh University in 1883, Prof. Paterson served his anatomical apprenticeship as a demonstrator in the dissecting-rooms of Edinburgh University under Sir Wm. Turner, and afterwards in Owens College, Manchester, under Prof. Morrison Watson. In 1888 he was invited to become the first occupant of the chair of human anatomy in University College, Dundee, and after labouring there for six years was elected to the Derby chair of anatomy in the University of Liverpool, a position which he occupied with distinction until his death. His intense public spirit led him to offer his services to the Medical Department of the War Office soon after the war commenced, and there is no doubt that his arduous duties as Assistant Inspector of Military Orthopædic Hospitals were accessory to his sudden and premature death. As an anatomist Prof. Paterson will be remembered for his contributions to our knowledge of the basal pattern in which nerves are distributed to the body, and particularly to the limbs, of vertebrate animals. That was the subject which first attracted his attention; his investigations led him on to an examination of the segmental character of the vertebrate body, particularly the variations which attend the segmentation of the sacral region. Most of his researches were published in the *Journal of Anatomy and Physiology*—now the *Journal of Anatomy*—but his monograph on "The Human Sacrum" appeared in the Transactions of the Royal Dublin Society (vol. v., 1893). In 1903, as a Hunterian professor at the Royal College of Surgeons of England, Prof. Paterson gave a series of lectures on "The Morphology of the Sternum," which was published in book form in the following year. In these lectures he maintained that the sternum must be regarded as a derivative, not of the ribs, but of the shoulder-girdle. He was also the author of several brochures on anatomy and embryology, as well as a contributor to standard text-books on human anatomy. Some of the essays which he printed for private circulation were pieces of real literature.

MR. E. H. STENNING, King William's College, Isle of Man, sends a description of a brilliant auroral display seen there on February 27. The luminous areas appeared at about 8.30 p.m., and increased in intensity until 10.10 p.m. They took the form of two large parallel arcs, extending across the northern sky. The brighter of the two bands, the inner, was so bright that no star appeared to shine through it. It was separated from the outer arc by a broad black band. The inner band seemed to be of fixed intensity, but the outer varied incessantly. In altitude the highest portion of the outer band was well above the central star of Cassiopeia, and the brightest portion of the band was about 4° below the lower stars of this constellation (10.10 p.m.). The luminosity of the outer band faded rapidly, beginning from the ends, and at 10.45 could not be seen. The inner band was still visible, though faintly, at 11.15.

INFLUENZA has again further increased in severity over the British Isles, and the Registrar-General's return for the week ending February 22 shows that the deaths in London and in the ninety-six great towns of England and Wales were more than double those of the preceding week. In London (county) the deaths from influenza were 653, which is greater than in any week since that ending December 7, and the deaths in the ninety-six great towns were 3046. The deaths from influenza in London had risen from 13 per cent. of the deaths from all causes in the preceding week to 25 per cent. in the week ending February 22. The deaths are still highest at the ages from twenty to forty-five, being 44 per cent. of the total, and there is some increase in the percentage of deaths above sixty-five years. Out of 12,939 deaths in London from influenza during the last twenty weeks there have been 5987 deaths at the ages twenty to forty-five, which is 46 per cent. of the total deaths from the epidemic. At the ages up to five years there were 12 per cent. of the total deaths, at five to twenty years 16 per cent., at forty-five to sixty-five years 17 per cent., at sixty-five to seventy-five years 6 per cent., and above seventy-five years only 3 per cent.

MR. J. REID MOIR describes in the February issue of *Man* a remarkable piece of carved chalk recently found by the Hon. R. Gathorne-Hardy in his park at Great Glemham House, Saxmundham, Suffolk. The specimen, measuring 4½ in. by 2⅞ in. by 2⅜ in., is of a dull white colour, and has sandy material embedded in the interstices. It is believed that it was brought to the surface by the action of rabbits, the burrows of which are very numerous at Great Glemham. Mr. Moir believes that, in its outline, the piece of chalk bears a very close resemblance to the outline of the mammoth (*E. primigenesis*), with which the scientific world has become familiar by an examination of carcasses of this animal found in the frozen ground of Siberia, and by drawings and outlines upon bone and other materials discovered in the Aurignacian and later Palæolithic deposits in France and elsewhere. The specimen certainly exhibits many remarkable points of resemblance to the mammoth, but the question remains whether these resemblances may not be accidental or the result of weathering. It may be advisable to await further examination by experts before we express a decided opinion upon this remarkable discovery.

WE have received a copy of the first issue of the *Balkan Review*, which is to be published monthly by the Rolls House Publishing Co. at the price of 1s. 3d. The editor is Mr. Crawford Price. The review aspires to cultivate financial and commercial relations between Britain and the Balkans, and to act as an organ of *liaison* between the West and the East. Its scope covers social, political, historical, and geographical aspects of Balkan lands. "While supporting the existing *entente* between Greece, Serbia, and Rumania, we shall hold the door ever open for the admission of a regenerated and reformed Bulgaria." The first number contains several interesting articles, including one on the Jugo-Slavs and another on the group of islands known as the Dodecanese.

THOUGH for skeletonising purposes the use of the tryptic digestion process has long been known, the method does not appear to have been much used in England. Miss Kathleen F. Lander directs attention to its great value in the *Museums Journal* for February. She finds that half a gram of trypsin in a litre of water makes the best solution, and to this is added a pinch of sodium bicarbonate to ensure alkalinity. If allowed to digest at a temperature of 37° C., the preparation of a skeleton can generally be completed within twenty-four hours. The method is superior to maceration in warm water only in so far as rapidity of action is concerned, and it is certainly costly. Trypsin—sold by Messrs. Burroughs and Wellcome—costs 50s. per ounce, and the solu-

tion, when ready for use, 1*s*. per litre. Fortunately, however, it retains its digestive action for a fortnight before the ferment is destroyed by bacteria, but its action becomes slower and slower.

IN the *Gardeners' Chronicle* of February 8 Mr. W. B. Brierley, writing from the recently established Institution of Pathological Research, Rothamsted, discusses the question of the diseased areas on orchid-leaves known to horticulturists as "orchid spot." This, he points out, is not a single and specific disease, but a congeries of diseases, all little understood and urgently in need of detailed investigation. From the casual examination of diseased specimens during the past two or three years Mr. Brierley has recognised seven distinct types of disease. Of these it is highly probable that four are the result of the action of parasitic organisms, one of local chilling of the leaf-tissues, one probably of atmospheric poisoning, and one of some other physiological derangement of the protoplasm, due probably to unsuitable cultural conditions in the plant's physical environment. A continuous and intensive study of "orchid spot" would doubtless show that the seven diseases are but a few of the many covered by this name. At present all these diseases are lumped together as "orchid spot," and horticulturists endeavour to control a disease of physical causation by a fungicidal spray, or a fungal epidemic by regulating to a nicety the temperature of the water supply. There is needed a detailed investigation of this group of diseases, a critical experimental study of the physiological relations of the plants to their environment, an understanding of all the complex hygienic factors involved, and a thorough elucidation of the life-histories and biological relations of the pathogenic organisms which may be present. Only on such a foundation can a rational scheme of prophylactic and therapeutic treatment be based.

THE Monthly Meteorological Chart of the East Indian Seas for February, issued by the Meteorological Office, shows in great detail the various meteorological data. Winds are given in an extremely intelligible and useful form for navigators, and aircraft can use much which has been primarily prepared for the seaman. The wind-zones show for each 5° of latitude by 5° of longitude both frequency and strength. The limits of the trades and monsoons are shown on the face of the chart, and tracks of some cyclonic storms are given. Results for the several elements are obtained from records extending over a period of about sixty years. Ice information is given on the back of the chart, and navigators voyaging in high southern latitudes will find the information very helpful in avoiding a common source of danger. There is a desire on the part of the Meteorological Office for captains who are interested in meteorology to assist in the work by observing for the Office. Naturally, the organisation has been seriously interrupted by the war, so that the assistance of voluntary observers is now the more urgent. The series of charts for the several months shows in the clearest possible manner the change of monsoon over the area of the sea embraced.

OUR ASTRONOMICAL COLUMN.

THE ORDER OF THE PLANETS.—In the oldest cuneiform inscriptions the planets are given in the order Jupiter, Venus, Saturn, Mercury, Mars (*vide* "Encycl. Brit.," eleventh edition, vol. ii., p. 796, "Astrology"). Dr. Herbert Chatley writes from Shanghai to point out that if we calculate the total gravitational force between the sun and each planet (viz. product of masses ÷ square of distance) we obtain results which in order of magnitude agree with the list above. With the latest values of the planetary masses the numbers are:—

Mercury, 0·24.	Mars, 0·05.
Venus, 1·58.	Jupiter, 11·76.
(Earth, 1·00.)	Saturn, 1·04.

This cannot be anything more than a coincidence, but it is sufficiently curious to justify mention. Dr. Chatley notes that if by chance the ancients had possessed the necessary knowledge, they would have grouped the planets, not by the simple attractions, but by their tide-raising power, which would have involved the inverse cubes of the distances.

CEPHEID VARIABLES.—The *Observatory* for February contains a letter by Mr. J. H. Jeans on the Cepheid problem. Mr. Jeans gives the following functional formula for the Cepheid light variation:—

$$a \cos nt + bf[n(t-\eta)],$$

where a, b, η are adjustable constants, and f is the same function for all stars. The spectral type follows the second term of the expression fairly closely, maximum value of f corresponding with early or B type, minimum value with late or K type.

The graph of the function f shows a steep rise followed by a much less steep and approximately exponential descent; its period is the same as that of the first term in the formula. This latter fact leads the author to the conjecture that the $a \cos nt$ term arises from the rotation of a single elongated body, and the bf term from an explosion which occurs in a particular orientation of the body, this explosion producing the change in spectral type. He shows that Mr. Phillips's Group I. of light-curves would be explained by one explosion per rotation, and Group II. by two explosions per rotation. There is, however, a difficulty in picturing a mechanism that could produce explosions in fixed orientations, for any external disturbing body would necessarily be changing its orientation.

VARIATION OF LATITUDE.—The observatories of Mizusawa, Carloforte, and Ukiah (all in N. lat. 39° 8′) continued their series of latitude observations throughout 1917. The results are discussed by B. Wanach in *Ast. Nach.*, No. 4969. The minimum latitude in the meridian of Greenwich was $-0{\cdot}14''$ at the end of March, the maximum $+0{\cdot}16''$ early in November. The track of the pole is considerably more contracted than in the two preceding periods.

Issei Yamamoto contributes a paper on the "Kimura" or "z" term in the latitude variation (Proc. Tokyo Math. Phys. Soc., second series, vol. ix., No. 17). He has made observations to test Prof. Shinjo's suggestion that the term arose from an annual term in the distribution of temperature in and above the observing-room, and consequent dissymmetry in the refraction.

He made a specially designed observing-room, with precautions to equalise the temperature of the air above it, and found that the "z" term was greatly reduced. His results thus tend to confirm Shinjo's suggestion.

The values of the variation of latitude that are adopted for the Greenwich reductions are deduced from the results obtained with the Cookson floating telescope. They are ready long before the publication of the results at the international stations, and it is found that they do not differ much from the latter.

THE HEALTH OF OUR CHILDREN.[1]

ONE feels on reading the report referred to below that the nation possesses in Sir George Newman a general with a plan, who, having consolidated the gains of ten years' work, is pressing on to his objective: the prevention of disabling diseases and the winning for every child of his birthright of a happy and healthy childhood. Such is the impression gained by a careful study of this most interesting and comprehensive report.

In section iii. will be found the results of a typical medical inspection conducted by a most competent observer—Dr. C. J. Thomas, of the London County Council. Two sets of three hundred unselected elder children each, in typical London and country schools, were inspected, and the results are described and analysed. One reads with dismay that "after deduction of the blind, deaf, mentally and physically defective, and invalid children drafted to special schools or absent from school, there were of the children present at school 21 per cent. found to be suffering from one or more serious defects . . . 12 per cent. were ill-nourished; 19 per cent. were unclean in body; of the London children 40 per cent., and of the country children 65 per cent., had some carious teeth; 11 per cent. suffered from disease of nose or throat; 10 per cent. had 'very serious' defects of vision; 6 per cent. suffered from defective hearing and 6 per cent. from severe anæmia; and of middle ear disease, of organic heart disease, of skin disease, and of spinal curvature of 'worst grade' there were in each case 4 per cent. of sufferers."

We agree with Sir George Newman's comment on these grim facts:—"No one, I think, can consider these findings or read Dr. Thomas's account of the physical condition of these children about to leave school for industrial occupations without understanding, once and for all, the gravity of the situation."

It is with a sense of relief one finds that a good deal is being done by several education authorities to remedy the defects found. There are still, however, a good many C3 authorities. Most hopeful of all, however, is the policy "broad and deep" which the Board of Education's Chief Medical Officer, since translated to the Local Government Board, has all along had in mind—the safeguarding of each and every child's health from babyhood up to and including school-life. This policy we find explained in his excellent exposition of those sections of the new Education Act which deal with the health of children and young persons.

"The Act," writes Sir George, "lays emphasis upon the broad fact that the purposes of the School Medical Service are not the detection of defects, the discovery of child-patients, and the treatment of such sick children, *but the advancement of the health and physical development of the whole child population of school age*."

The author of this report does not rest content with a recital of first principles. He points the way to their realisation. Thus we find much practical advice on the teaching of hygiene and mothercraft, on the control of juvenile employment, on open-air schools, on physical education, on play-centres, and on holiday camps. We note with pleasure his reference to the cheery brotherhood of Boy Scouts.

Everyone interested in education, and therefore in our children, should study this inspiring report. Certainly the *personnel* of the School Medical Service must realise that they have had as chief, not only an eminent expert, but also a man of large vision, a leader who really leads.

W. E. H.

[1] Annual Report for 1917 of the Chief Medical Officer of the Board of Education. (Cd. 9206.) (H.M. Stationery Office.) Price 1s. net.

FORTHCOMING BOOKS OF SCIENCE.

BIOLOGY.

Ginn and Co. (Boston, Mass., and London).—An Elementary Biology, Gruenberg; Manual to Elementary Biology, Gruenberg. *Oxford University Press.*—Mammalian Physiology: A Course of Practical Exercises, Prof. C. S. Sherrington. *John Wiley and Sons, Inc. (New York), and Chapman and Hall, Ltd.*—Economic Woods of the United States, Prof. S. J. Record; Forest Management, A. B. Recknagel and J. Bently, jun.; Bacteriology and Mycology of Foods, Dr. F. W. Tanner, illustrated.

CHEMISTRY.

Ginn and Co. (Boston, Mass., and London).—Notes on Qualitative Analysis, Test and McLaughlin. *John Wiley and Sons, Inc. (New York), and Chapman and Hall, Ltd.*—Commercial Oils, I. F. Lauchs; Manual of the Chemical Analysis of Rocks, Dr. H. S. Washington.

ENGINEERING.

Benn Bros., Ltd.—Electrical Measuring Instruments: Their Design, Construction, and Application, Dr. C. V. Drysdale and A. C. Jolley; Electric Traction on Railways, P. Dawson, illustrated; The Handling of Materials: A Manual on the Design, Construction, and Application of Cranes, Conveyors, Hoists, and Elevators, being the second edition of Electric Cranes and Hoists, H. H. Broughton, in four volumes, vol. i.; The "Electrician" Annual Tables of British and Foreign Electricity Undertakings; and new editions of Electric Mains and Distributing Systems, J. R. Dick and F. Fernie, and Electric Switch and Controlling Gear, Dr. C. C. Garrard. *Sir Isaac Pitman and Sons, Ltd.*—Electric Mining Machinery, S. F. Walker, containing chapters on prime-movers, signalling, telephony, shot-firing, etc.; Reinforced Concrete, W. N. Twelvetrees, dealing with the subject from the theoretical and practical points of view; Gas and Oil Engine Operation, J. O'Kill; Papers on the Design of Alternating-current Machinery, C. C. Hawkins, Dr. S. P. Smith, and S. Neville; Storage Battery Practice, R. Rankin; Electrical Engineers' Pocket-Book, edited by R. E. Neale, being a thoroughly revised edition of the volume originated and edited by K. Edgcumbe. *John Wiley and Sons, Inc. (New York), and Chapman and Hall, Ltd.*—Waterproofing Engineering: For Engineers, Architects, Builders, Roofers, and Waterproofers, J. Ross; Geodesy and Geodetic Surveying, Prof. G. L. Hosmer; Principles of Transformer Design, Prof. A. Still; Oxy-Acetylene Welding Manual, Lieut. L. Campbell, jun.; Essentials of Alternating-current Electricity, W. H. Timbie and Prof. H. H. Higbie; Vital Statistics, Prof. G. C. Whipple; and new editions of Irrigation Engineering, Dr. A. P. Davis and H. M. Wilson; Compressed Air Plant: The Production, Transmission, and Use of Compressed Air, with special reference to Mine Service, Prof. R. Peele.

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METEOROLOGY DURING AND AFTER THE WAR.[1]

DURING the past four years and a half of hostilities meteorology has, like many other branches of knowledge, been utilised in naval and military operations to a far greater extent than ever before. Consequently, there are now a large number of officers in the Services who have had practical experience of the value of meteorological information when it has been prepared from sufficient data, and by men who have been thoroughly trained in the subject. It is, therefore, highly desirable that full advantage should be taken of the experience which has been gained during the war in order to meet, as adequately as possible, those demands which will be made upon meteorology in the general reconstruction which is now beginning.

In some ways the conditions which prevailed during hostilities were favourable to advances in the subject. Special facilities were given for the rapid transmission of reports; kite-balloons could furnish series of observations at various heights; aeroplanes were available to observe the temperature in successive layers of the atmosphere up to 12,000 ft. or 14,000 ft.; the velocity and direction of air-currents up to even 25,000 ft. were determined by the bursting of shells fired at high angles; pilot-balloons at perhaps a hundred stations were observed four or more times daily. In these and other ways a vast store of information has been amassed which has already been utilised, but remains available for much more detailed study in the immediate future; and not the least difficult problem will be to reduce the mass of information to a manageable and orderly arrangement.

There were in 1914 in this country the State Meteorological Service (the Meteorological Office) and a Naval Meteorological Service, which had been formed in 1913 to meet the needs of the Royal Naval Air Service. Besides these, a private institution, the British Rainfall Organisation, collected and discussed observations of the rainfall of the British Isles and studied all questions connected with rainfall; also two scientific societies—the Royal Meteorological Society and the Scottish Meteorological Society—specially devoted themselves to the advancement of meteorological science. It will be seen, therefore, that only the State service could provide a career for anyone desiring to take up meteorology as a profession, and as the staff of this service was comparatively small, it is scarcely surprising that the great majority of meteorologists were amateurs in the sense that they studied the subject from their interest in it, outside their ordinary occupations.

In the Meteorological Office the policy for some years had been to bring in men who had had a thorough scientific education at a university and to encourage them to devote it to the study of the many problems which meteorology had to offer. This was a great advance from the empirical treatment of the subject, and has been amply justified by the success obtained when this policy has been tested under the conditions of active service.

For the general public current meteorology was mainly represented by the daily forecasts and the weather summaries which appeared in the Press, and the cases in which these failed to describe accurately the weather in the reader's immediate locality usually impressed him more than their general accuracy as tersely worded descriptions of conditions which were likely to prevail over an extended area, such as south-eastern England, but those who had only been brought into contact with meteorology in this superficial way on the outbreak of hostilities soon found that the weather affected their preparations and their operations at every turn. It was scarcely to be expected in these circumstances that all Staff officers would at once realise what information trained meteorologists could provide, or to what extent their reports and warnings could be relied upon in practice.

In the course of the last two decades investigations have been extended from the surface of the earth into the air by means of kites and balloons, and our knowledge of the conditions prevailing up to ten, and even fifteen, miles above the earth's surface has thereby been steadily increased. Self-recording instruments continuously registering the pressure, temperature, and humidity have been carried up through the lower seven miles (11 kilometres), the troposphere—the region in which the temperature falls with increasing height—and far into the stratosphere above it, sometimes to heights of 12½ miles (20 kilometres) or more. In this way the remarkable fact of the differentiation of the atmosphere into the lower troposphere and the overlying stratosphere has been established, and further investigations indicate the great importance of these upper regions of the atmosphere in the solution of many problems relating to the weather.

With the gradual introduction of balloons and aircraft into the Army, and the subsequent formation of the Royal Flying Corps, meteorological establishments were formed at South Farnborough in 1910 and at Upavon in 1913, where the study of the upper air was carried on regularly. In this way, and with the material furnished by the meteorologists of other countries, a very large amount of information had been collected, and, to a large extent, discussed and utilised, before the outbreak of war, but this was, for the most part, known and appreciated only by those who were especially interested in the subject, and the bearing of the results obtained had not reached the wide circle of those who were later to become acquainted with them under the exacting conditions of active service.

On the outbreak of hostilities some lines of work had to be abandoned, and new lines taken up at once. Many of the staff of the State service joined the Army in those early days who would have been very profitably employed in the meteorological units which were formed later, or even in the Office itself, where the work became ever increasingly heavy, while the task of replacing those who went on service became constantly more difficult.

On the outbreak of war in August, 1914, meteorologists were at first considerably handicapped by the reduction of their supply of information. Wireless reports from ships ceased; weather telegrams from Germany and Austria were no longer available; and Central Europe became a blank on the working charts of the Meteorological Office. The censorship over all inward and outward telegrams disorganised the supply of meteorological information from Allied and neutral

[1] From a paper read before the Royal Society of Arts on January 22 by Col. H. G. Lyons, F.R.S., Acting Director of the Meteorological Office.

countries for a while, but this was soon rectified, and daily weather reports could again be prepared, though lacking part of the Continental information. As time went on the need for more and more distant stations was felt, and by 1916 reports were being regularly received from Spitsbergen to the North African coast and Cairo, and from Iceland and the Azores to the Russian stations of Petrograd, Nicholaieff, Sebastopol, and Batum.

The supply of daily weather reports and forecasts to the public was stopped, but their preparation was continued actively in the Meteorological Office, where the telegraphic reports which were collected several times daily reached the number of about one hundred, and the information which they contained was compiled on working charts from which the forecasts were prepared. These were issued to the Admiralty, to various dockyards, to the Grand Fleet, various battle squadrons, submarine flotillas, etc., each of which required reports and forecasts adapted to their special needs. Similarly information was supplied to the Naval Meteorological Service for the Royal Naval Air Service, and to numerous units of the Royal Flying Corps, or the Royal Air Force as it afterwards became.

To provide information for aviators in the early morning or for use in preparing plans for the day's operations, it became necessary to take observations in the early hours of the morning. and 3 a.m. was the hour chosen at first, but this was not found to be early enough, and 1 a.m. was finally adopted, making the observing hours 1 a.m., 7 a.m., 1 p.m., and 6 p.m. Thus a continuous twenty-four-hour forecasting service was established, and has been maintained in operation up to the present time, to prepare forecasts and reports four times daily; and to telegraph the observations taken at selected stations to the Meteorological Section at the British General Headquarters in France, and to other stations that required them, as well as to the Meteorological Service of the French Army, and later to that of the American Expeditionary Force.

Under service conditions something simpler, plainer, and more direct in its presentation of the opinions of the trained meteorologist who prepared it than the ordinary daily weather report with its statistical data was needed. Those who had to make use of the daily weather reports were usually far too busy to wish to study the statistical material before accepting the meteorological opinions which were offered to them. They wanted a direct statement of expert opinion which they could make use of in preparing their own plans of action. The desire for such expert assistance was also shown by many requests that forecasts should be expressed in "perfectly simple and non-technical language." To this very reasonable request it is not so easy to accede as it may seem. Such expressions as "a depression advancing from the westward," "a secondary depression developing over the Channel," "an anticyclone spreading northward," are more than mere statements of fact; they convey to all who are acquainted with meteorology much additional information depending on the weather conditions described, which it would take several paragraphs to state simply and in non-technical language.

So far as meteorological conditions could be set out in plain language, this was done in these special daily weather reports, which were issued in the early morning, before noon, and in the afternoon to all who required them; and these were supplemented by special summaries, one of which dealt with the prevailing and the prospective weather conditions on all fronts where military operations were in progress, and another with the weather conditions in the various sea areas round Europe.

The whole of this information was of a highly confidential character, since Germany and Austria were cut off from all weather reports from meteorological stations to the westward, except those of neutral countries, Norway and Spain.

We shall doubtless learn eventually to what extent the precautions taken sufficed to prevent information about the weather conditions over the British Isles and to the westward reaching the Central Empires, but at the time we had to depend mainly on negative evidence. It was not difficult to estimate from the working weather-chart what sort of forecast the enemy meteorologists would probably make on the assumption that the information from a wide area to the westward of them was not available, and this was done daily as part of the routine of the Meteorological Office. In the case of attacks by enemy aircraft it was fair to assume that his meteorological service considered the conditions to be reasonably favourable; and this was compared with the estimate of his opinion which had been formed here. Occasionally enemy forecasts were available, and these were compared in the same way. Negative evidence is not conclusive, but the impression that we gained was that little, if any, meteorological information of value was obtained from our area.

Many cases could be cited where operations were undertaken by the enemy which it seemed very unlikely that he would have undertaken had he possessed the information which we had here.

By the spring of 1915 two branches of the Army, the Royal Flying Corps and the Special Brigade, R.E. (Chemical Warfare), had decided that they required the co-operation of trained meteorologists who could explain the meaning and the limits of the forecast, answer questions or give advice, and arrange for fuller or more suitable information being furnished when required.

These demands for the provision of trained meteorologists in France led to the formation of a meteorological section as a unit of the Corps of Royal Engineers which had at first a strength of about four officers and twenty non-commissioned officers, but the establishment was repeatedly increased until, when hostilities ceased, it consisted of thirty-two officers and about two hundred other ranks, and provided sections for duty, not only in France, but also on the Italian and Macedonian fronts, besides a reserve section at home. From a small unit at General Headquarters in France the organisation developed until there was a meteorological unit with each army and one with the Independent Force, R.A.F., these units having their groups of observers and pilot-balloon stations reporting to them. The telegraphic weather reports from the stations in the British Isles, as well as those received from a large number of European stations, were at first thrice daily, and later four times daily, telegraphed from the Meteorological Office in London to the Meteorological Section at General Headquarters in France, in order that weather-maps might be drawn and forecasts prepared there as might be required. This information was supplemented by data which the Meteorological Section collected from its station on the British front, and also from other parts of France through the French Meteorological Services.

In this way on the Western front, and similarly at later dates on the Italian and Macedonian fronts, a network of meteorological stations was built up, which, with the addition of the data and reports furnished by the Meteorological Office, enabled the meteorological officers to supply the information which the different Services required for their special purposes, to issue forecasts and weather warnings, and also, as will be seen later, to increase very materially the accuracy of the work of some of the Services.

The task of providing the *personnel* for this military unit was no easy one, for, as has been already men-

tioned, the staff of the Meteorological Office was small, and outside it there were very few expert meteorologists who were available. At first three of the senior staff of the Meteorological Office received commissions for duty in France, and afterwards a number of men who had a thoroughly scientific education at a university joined the Meteorological Office for longer or shorter periods of training before being posted to the Meteorological Section, and in this way a high-grade scientific staff was formed and maintained. To a training which included especially mathematics and physics was added as much instruction and practice in advanced meteorology as could be given in the time available, and on the basis of such an education the meteorological aspect of the problems was quickly appreciated.

As time went on the scope and number of such reports and warnings steadily increased until there was a regular and continuous flow of information sent out from meteorological offices to various branches of the Service for them to utilise as best fitted the operations in hand. The Royal Air Force required forecasts of weather for short periods which it could use for its reconnoitring and bombing squadrons; for day operations reports of the wind direction and velocity obtained from pilot-balloon ascents and high-angle shell-bursts were communicated from different altitudes up to 20,000 ft.; for night operations information for lower levels sufficed, and the arrangements had to be modified. For high altitudes a central station could supply information adequately, but when data concerning lower levels became important, where the air turbulence set up by friction with the earth's surface became a material factor, the reports were more effectively supplied by local stations where the special conditions could be more effectively studied. For all this the most rapid means of transmission is essential; for the shorter the forecast period, and the more detailed the forecast in its information, the more rapidly must it be placed at the disposal of the aviator if it is not to mislead him. These reports were largely supplemented by telephone inquiries by those interested, and a precision was demanded which was often very difficult, and sometimes impossible, to attain. Success in answering these inquiries is reached by having as meteorological officers men who have an acquaintance with the physical condition of the region, and also possess such a scientific training that they instinctively proceed from cause to effect, and facts at once fall into their place in their minds. This is very different from the acquired skill of an empirical forecaster, who can never attain the same confidence in his opinion. The work of a meteorological officer who has to advise on the suitability of conditions for long flights, especially on active service, is very responsible, and throws a great strain on him, since he cannot but feel that on his advice great risks may be taken and grave danger encountered. In regions where high plateaux exist near the sea-coast, as in Macedonia, the cold-air currents which stream downwards, by reason of their greater density, to lower levels often attain full-gale velocity, blowing in violent gusts, and constitute an element of serious danger to aviators. The conditions which favour such a phenomenon are known and recognisable, but it may be very difficult to say precisely whether or not the descent of cold air will take this violent form.

In chemical warfare a different set of problems was encountered. Here we are concerned with the movement of air-currents close to the surface of the ground, affected by all its irregularities, diverted this way and that by obstacles, and generally in that state of irregular motion known as turbulence in which eddies form, break up, and re-form, greatly complicating the conditions. At night, too, when the surface wind may die down to a calm and the ground cools under a clear sky, the colder and heavier air streams down from higher ridges into valleys and low ground. Consequently the direction and velocity of air-currents along the front had constantly to be observed and studied in relation to the relief and conditions of each section; so long as the wind was favourable for enemy operations, or even likely to shift into a favourable quarter, observations, reports, and warnings were unceasingly needed.

But, besides the aviators, there are other branches which are vitally interested in the conditions which prevail in the upper air. Projectiles leave the firing-point and traverse a considerable thickness of the atmosphere during their flight, reaching an altitude of about 10,000 ft. for a fifty-second trajectory. In its passage through the air a projectile traverses strata of different temperatures, and consequently of various densities, so that a correction has to be applied to the range-tables. On a winter day, when the temperature at the surface is 3° F., the temperature at 3000 ft., 6000 ft., and 9000 ft. may be 15° F., 16° F., and 12° F. respectively, so that any correction based on the temperature near the ground would be wrong. Also the wind varies considerably, and often irregularly, both in velocity and direction as the ground is left, so that a correction based on mean conditions here will probably be widely different from that which should be used on any particular occasion.

These considerations led to a much wider application of meteorological information to the practical correction of gunnery than had hitherto been employed, and reports of upper-air temperature and of the velocity and direction of the wind at various altitudes were regularly prepared and transmitted from meteorological stations along the various fronts. This increased application of meteorology to ballistics raises many problems of interest and importance, which demand for their solution the co-operation of scientific gunnery and meteorological science of the highest order.

To mention another field, the sound-waves which are recorded in sound-ranging, that wonderful adaptation of the physical instruments of the laboratory to practical use on the field of battle, traverse the lower layers of the atmosphere, and as higher and higher accuracy was aimed at, it became clear that meteorological observation must be made concurrently, and utilised in order to attain the desired precision.

Frequent mention was made during the war of the meteorological efficiency of the enemy's organisation and of the very favourable conditions which he experienced during many of his operations; his superiority in these directions was not infrequently assumed. It is not possible to compare the effectiveness and success of the rival organisations until much more information is available and, in the discussion and investigation of past operations, the various contributing factors have been sorted out and duly weighed. No doubt Germany started with a much larger number of men who had received a scientific training in the subject, for professors of meteorology existed at several universities; the appreciation of the subject and its practical value, too, may have been more general among that nation; but, as a personal opinion, I do not believe that it attained a higher standard than our own. Many apparently did not realise that the occurrence of bad weather during operations did not necessarily mean that the commander and his staff had no information regarding the impending weather changes; but weather is only one of many factors which have to be taken into consideration, and it must often be

that operations planned and prepared must be carried out whatever the weather may be, though a good forecast may at the last moment enable him to judge whether nearer or more distant objectives are likely to be attained.

Free discussions and conjectures on the subject of the enemy's advantages and the necessity for maintaining a strict silence regarding the details of our organisation naturally led many to doubt whether adequate steps had been taken to utilise meteorology to the full. Many offered their services as forecasters of experience, or as having methods which they considered could give highly trustworthy results, but they did not realise that much more was needed than a brief description of general weather conditions. They did not know that a large and somewhat intricate organisation had been found necessary, in which each man played his appointed part, and from the combined results of whose labours the required information was evolved.

There are now four State meteorological services in operation—the Meteorological Office, the Admiralty Meteorological Service, the Meteorological Section, R.E., for the Army, and the Meteorological Service, R.A.F., of the Air Ministry—and the relations and the means for co-operation between these four services will have to be worked out, and a number of considerations taken into account.

So far as the study of the weather and the issue of forecasts is concerned, short-period meteorology, as it may be called—rapidity of transmission of the observations to the Central Office, where they are discussed and compared, and of the forecasts, warnings, etc., which are sent from it—is the first essential, and the needs of aviation have only accentuated this. Observations should be in the Central Office for the forecaster's use not later than one hour after they are taken if he is to get out his reports and warnings early enough to be of effective use to aviators. This will mean a considerable acceleration in the collection and transmission of reports from some parts, for a country's own reports are not enough; those from selected stations in the surrounding countries are needed in order to form a correct view of the changes that are taking place. Wireless telegraphy will assist in meeting such requirements, and each country will soon, it is hoped, send out the meteorological observations taken at some ten to fifteen of its selected stations four times daily at fixed hours. French observations are already being sent out thrice daily from the Eiffel Tower in this manner, but some organisation will be necessary to bring this into operation as a general practice. With foreign reports collected in this way, and special priority for the necessary number of inland reports, forecasts could be got out more quickly, and, consequently, be of far greater utility.

Only a small proportion of the observations which are taken can ever be printed and published, so all working meteorologists must often refer to the voluminous collection of manuscript data which every meteorological service accumulates. Where research into the problems of the atmosphere is to be actively carried on there must be free access to such a collection, as well as to a well-stocked library on the subject.

All these considerations indicate the desirability of a close contact and co-operation between all the meteorological services in a country, so that the whole material may be available to each, that the scientific staff of each may be able to discuss the points which may arise, and that information may be quickly and easily distributed.

Aviation, with its prospect of long-distance communication, has rendered necessary a readjustment of meteorological relations within the Empire. Canada, South Africa, Australia, New Zealand, India, and Egypt and the Sudan have all their well-equipped meteorological services, which include networks of stations so selected as to represent most suitably the different meteorological conditions prevailing in those regions. In each there is a scientific staff studying the problems that arise or affect the economic life of the country. Except as students of the same science, the interests of each service have been somewhat diverse from the nature of the requirements which each had to meet, but in future we must organise the provision of all information that aviation may require; and since aviators are going to pass from continent to continent and from one country to another, uniformity of some kind must be attained in respect of the assistance that meteorology is to give.

From the organisation necessary for Imperial co-operation to that of international co-operation is but a step, and the same requirements have to be considered; but some additional complications, such as variety of units, have to be reckoned with. But these have been successfully dealt with in the past; and as for many years the international work of meteorological services has paved the way for steady advance in our science, we may look with confidence to even greater progress in the future. The problems that press for early investigation are too numerous to recite, but a few may be mentioned.

The relation of meteorology to gunnery must be continued and the study of the many problems involved carried on by competent men.

The air routes of aerial transport will have to be studied and all the information now available must be sorted out, investigated, and discussed in order that it may be put in the form most suitable for use by airmen. This will demand much additional observing at many places besides the discussion of existing material, but unless this is done as part of a concerted scheme much unnecessary expense will be incurred, and the results will fall far short of what they should be, since all the data must eventually be worked up in connection with that from other places, and if all are not of the same scientific standard they cease to be comparable, and must often be rejected in discussion.

Many of the stations in the Crown Colonies can afford most valuable information in this connection if expert meteorologists are available to carry out the work. An observant traveller in Dahomey has remarked upon the presence of a steady north-easterly current at about 6000 ft. to 7000 ft. over the lower currents of the south-western monsoon of West Africa, and such information, if substantiated and extended, may be of material importance in this region.

While overland observations are numerous, and have been extended by means of *ballons-sondes*, aeroplanes, etc., to very great heights, our knowledge of the atmosphere over the sea is much less complete. By means of ships equipped for the purpose, such observations can be, and have been, made in certain parts, but this line of investigation must be extended if our knowledge is to be adequate.

Besides these more evident needs of aviation there are many problems of great practical importance which merit a closer and more thorough investigation than they have yet received. Among these may be suggested those violent disturbances known as hurricanes and typhoons. Recent theoretical investigations have thrown much light on their nature, and a further study of the evidence which exists should greatly add to our knowledge of them.

Variation of rainfall is always a matter of import-

ance, and in countries where it is barely adequate for agriculture any diminution of it is a serious matter, and such cases call for careful investigation.

The war has given a great impulse to meteorology by showing its possibilities to all, and aviation has made, and is still making, more and more demands upon it for information of every kind. Co-ordination between the services of each country and effective co-operation between the meteorologists in all parts of the Empire are the first essentials for meeting quickly and adequately the demands which will be made.

The "Manual of Meteorology" which Sir Napier Shaw has in hand will be of the greatest value in the work before us, for it will place in the hands of every meteorologist and student of meteorology a masterly treatise on those aspects of our science which he has studied for years, and of which he is the acknowledged exponent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the annual meeting of the Court of Governors of the University, held on February 27, the Principal, Sir Oliver Lodge, announced his intention of resigning his post at the end of the present session. He said that, having passed the age-limit of the professorial staff, he wished to make way for a younger and more ambitious man, who would begin his duties with the period of reconstruction. He himself intended to devote the remainder of his life to the study of the æther of space in both its physical and psychical aspects. In seconding a resolution of deep regret, proposed by the Vice-Chancellor, Sir Richard Threlfall spoke in warmly appreciative terms of Sir Oliver Lodge's scientific work, especially in electrolysis, in the electrical deposition of smoke, and in wireless telegraphy, which had been of very great benefit to industry and to the world at large.

Sir Oliver Lodge, who took office nineteen years ago as first Principal of the University, has rendered invaluable service both to the University and to the city, and the close connection between the two which now exists is perhaps the best tribute to his work as head of the former. When the University first came into existence, as the result of the efforts of a very small but far-sighted body of men, it is not too much to say that the great majority of the citizens regarded it as a very unnecessary and entirely useless institution, which for some obscure reason Mr. Joseph Chamberlain considered a subject of vital importance to the city. To-day, however, this attitude has changed, and the University has become an integral part of the civic life of the city. This change, the magnitude and significance of which can be fully appreciated only by those who have witnessed it, is due in a very large measure to the personality and activity of Sir Oliver Lodge. He has not only convinced the public of the material advantage to be derived from having in its midst a centre of scientific teaching and research, but has also unceasingly insisted on the value of the humane studies to the life of the community. He has, in fact, taken a large and honourable share in laying well and truly the foundations of higher education in Birmingham.

CAMBRIDGE.—Dr. J. B. Hurry has offered to increase the value of the Michael Foster research studentship in physiology, founded by him in 1912, and tenable biennially, from a hundred guineas to 200*l*. A gift of three successive sums of 100*l*., to be paid at intervals of six months, has been offered for the assistance of research in the zoological laboratory by a benefactor who desires to remain anonymous.

Mr. W. M. Smart, of Trinity College, has been appointed chief assistant at the observatory.

The professorship of mechanism and applied mechanics, which was held by the late Prof. Bernard Hopkinson, has been formally declared vacant, and candidates are requested to communicate with the Vice-Chancellor on or before Monday, March 17.

LONDON.—The tenth annual report of the Military Education Committee of the University (for the year 1918), which has been presented to the Senate, refers with gratification to the letter from the King in which his Majesty sent an assurance of the interest with which he had learnt that the University of London Officers Training Corps continued "to uphold the record of splendid services which it has rendered in the past." The number of commissions granted to cadets and ex-cadets of the University of London O.T.C., and to other graduates and students recommended by the committee, increased during the year from 4040 to 4413. First commissions in the Army, Navy, or Air Force have been granted to 4101 former cadets. Of these officers 584 have fallen in the war. The number of distinctions gained by former cadets up to the end of 1918 is 1175, including V.C., 4; D.S.O., 39 (including three with a bar); Military Cross, 442 (including three with two bars and twenty-nine with one bar); Croix de Guerre, 21; Médaille Militaire, 1; mentioned in despatches, 480 (mentioned four times, 3; thrice, 16; twice, 56). A roll of war service for the University of London O.T.C. is being prepared, and will be published as soon as possible.

A sum of about 5133*l*. has been accepted by the Senate on the bequest of the late Dr. William Julius Mickle for the establishment, in honour of his great-grandfather, William Julius Mickle, the poet, of an annual fellowship to be awarded to graduates of the University resident in London who have specially distinguished themselves in the advancement of medical art or science.

OXFORD.—On March 4 the preamble of a statute making Greek optional in Responsions passed Congregation by 123 votes to 63. The statute was introduced by Mr. E. Barker, of New College, supported by the Regius professor of Greek, and opposed by the Regius professor of divinity and Mr. E. M. Walker, of Queen's. If the statute passes Convocation in its present form, natural science will be brought into Responsions for the first time, either this subject or mathematics, or a combination of the two, being made compulsory.

UNDER section 28 of the Education Act, 1918, which the Board of Education has now announced will come into operation on April 1, the persons responsible for the conduct of schools and educational institutions in England and Wales are, subject to certain exceptions, required to send to the Board of Education, Victoria and Albert Museum, South Kensington, S.W.7, before July 1, the name and address and a short description of the school or institution. The information is not required from the following schools and educational institutions:—(1) Schools and educational institutions in receipt of grants from the Board of Education or the Board of Agriculture. (2) Elementary schools certified by the Board of Education as efficient. (3) Secondary schools recognised as efficient under the Board's regulations. (4) Universities and university colleges. (5) Poor Law schools and schools certified under Part IV. of the Children Act, 1908. (6) Educational establishments under the administration of the Army Council or of the Admiralty. The responsibility for giving the

required information attaches to the secretary or person performing the duties of secretary to the governing body, or, if there is no governing body, the headmaster or person responsible for the management of the school or institution. Notice will be given in due course as to any further particulars which may be required under regulations made by the Board of Education. The Act lays it down that if such responsible person fails to furnish the information required, he will be liable to certain specified penalties. The particulars now demanded are necessary so that the Board of Education may have available the full facts as to the provisions for education in England and Wales, and of the use which is being made of them.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 20.—Sir J. J. Thomson, president, in the chair.—S. S. **Zilva** and E. M. **Wells**: Dental changes in the teeth of the guinea-pig produced by a scorbutic diet. The structure of the teeth of guinea-pigs subsisting on a scorbutic diet undergoes radical changes. The ultimate change is characterised by the total disorganisation of the pulp, including the odontoblastic cells. The earliest modification is observed at a period when no other systemic abnormality can be recorded with certainty, and is characterised by the alterations in the odontoblastic cells and by the dilatation of the blood-vessels of the pulp. Monkeys' teeth are also affected when these animals exist on a scorbutic diet. The bearing of the above results on human subjects is discussed.—W. E. **Bullock** and W. **Cramer**: A new factor in the mechanism of bacterial infection. The bacteria of gas-gangrene (*B. welchii, Vibrion septique*, and *B. oedematiens*) and of tetanus, when completely freed from their toxins, either by washing or by heating to 80° for half an hour so that spores are formed, do not produce the specific disease when injected into a mouse or a guinea-pig. The normal animal disposes of the bacteria mainly by lysis, and partly also by phagocytosis, and this defensive mechanism is so efficient as to render these bacteria non-pathogenic when injected by themselves. If a small dose of a soluble, ionisable calcium salt is injected together with the bacteria of their spores, the specific disease is elicited in a very virulent form. The chlorides of sodium, potassium, ammonium, strontium, and magnesium, when injected together with *B. welchii*, are not capable of producing gas-gangrene. From these experiments and other experimental evidence the conclusion is drawn that calcium salts, when injected subcutaneously, produce a local change in the tissues at the site of injection. The effect of this dosage is to bring about a local breaking down of the defensive mechanism against the bacteria of gas-gangrene and tetanus. The term "kataphylaxis" is proposed to designate this new phenomenon. Sterile watery extracts of earth are capable of producing this phenomenon.—Major W. J. **Tulloch**: The distribution of the serological types of *B. tetani* in wounds of men who received prophylactic inoculation, and a study of the mechanism of infection in, and immunity from, tetanus. In a previous communication to the Royal Society it was shown that *B. tetani* was susceptible of classification into a number of groups differing one from another in their serological reactions. As this finding might have an important bearing on the preparation of anti-toxin, as many strains of *B. tetani* as possible were investigated by the agglutination method: (i) from cases of the disease; (ii) from wounds of men showing no evidence of tetanus. The results obtained show that Type I. bacilli are but relatively infrequently obtained from wounds of inoculated men suffering from tetanus. Thus 19 out of 25 (76 per cent.) strains obtained from the wounds of men who showed *no* evidence of tetanus proved to be Type I. bacilli, while 41 per cent. of the strains obtained from men suffering from the disease proved to be of this type. This observation suggested that there was possibly a mono-typical immunity to each serological type, for the serum used for prophylaxis was prepared mainly from the products of Type I. bacilli. Experiments show that mono-typical anti-toxin neutralises the toxins of all the types. The precise quality, as well as the degree, of tissue debility produced by injury is of importance in initiating the process of infection in tetanus.

Zoological Society, February 18.—Dr. A. Smith Woodward, vice-president, in the chair.—R. I. **Pocock**: External characters of existing Chevrotains (Tragulina). The Indian species, commonly cited as *Tragulus memminna*, differs in so many important characters from the Malaysian species that it is necessary to sever it from them as a distinct genus, for which the name Maschiola, used by Thomas in a sub-generic sense, is available. In the absence of the interramal scent-gland, in the structure of the penis, and in the retention of shots on the pelage, Maschiola is a more primitive type than Tragulus, and resembles the still more primitive West African genus Hyomoschus.—K. M. **Smith**: A comparative study of certain sense-organs in the antennæ and palpi of Diptera.

Institution of Mining and Metallurgy, February 20.—Mr. Hugh F. Marriott, president, in the chair.—S. J. **Truscott**: Slime treatment on Cornish frames: supplements. This paper, which is one of a series published by request of the Tin and Tungsten Research Committee, relates to a number of experiments conducted with the view of determining the comparative values of fluted and plane surfaces, the most suitable length of bed, and other details connected with the improved recovery of tin in Cornish mills. A number of tests are recorded, made under varying conditions, and the results are embodied in a *résumé* which, after noting the factors governing frame-working which are thereby established, further deals with conclusions in respect to policy, with particular regard to rapid enrichment and complete fine grinding. The paper is illustrated by flow sheets explaining the practice on various Cornish properties.—E. **Edser**: The comparison of concentration results, with special reference to the Cornish method of concentrating cassiterite. This paper embodies an attempt to determine the relation between the enrichment attained by repetition of the concentration process, and the cassiterite that is lost. It is first assumed that the assay of any small increment washed off the surface used for concentration is proportional to the assay of the material on the surface, and it is shown that the assumption is correct, the amount of cassiterite lost during a complete washing being inversely proportional to the n^{th} power of the enrichment effected. The value of n thus indicates the economy of the process; the smaller the value of n the more economical will be the process. Experimental data are shown to support the conclusions reached, but additional investigations are called for.—G. F. J. **Preumont**: Wolfram mining in Bolivia. In view of the fact that wolfram is a product of outstanding importance, and that Bolivia is now yielding quite a considerable proportion of the world output, this paper should be of timely interest. A collection of statistics showing the production and distribution of wolfram in Bolivia

is followed by detailed descriptions of the principal mines and deposits, and particulars of the costs, system of working, conditions of labour, and mining laws.—C. W. **Gudgeon**: The Giblin tin lode of Tasmania. This is a deposit which has so far not been the subject of any published description. Like many another property which has since made good, this lode experienced a chequered career before reaching its present position. The author considers this to be a good example of persistence of ore in depth.

MANCHESTER.

Literary and Philosophical Society, February 18.—Mr. W. Thomson, president, in the chair.—Dr. H. **Wilde**: The mutual relations of natural science and natural religion.—J. Wilfrid **Jackson**: (1) "Shell-pockets" on sand dunes on the Wirral coast, Cheshire. The paper consisted of a short account of "shell-pockets" in general, and contained remarks on the age of the buried land surfaces in the neighbourhood. (2) A new Middle Carboniferous Nautiloid (*Coelonautilus trapezoidalis*). The species is founded upon two specimens: one from the Lower Coal Measures near Colne, erroneously figured by Wild in 1892 as *Nautilus subsulcatus*, the other from the Pendleside series, Pule Hill, Marsden. The species differs from *C. subsulcatus* in several important details, but presents some affinity with *C. quadratus*.

EDINBURGH.

Royal Society, January 20.—Dr. John Horne, president, in the chair.—Prof. **Harvey-Gibson** and Miss Elsie **Horsman**: Contributions towards a knowledge of the anatomy of the lower Dicotyledons. II.: The anatomy of the stem of the Berberidaceæ.—Also Miss Christine E. **Quinlan**: Contributions towards a knowledge of the anatomy of the lower Dicotyledons. III.: The anatomy of the stem of the Calycanthaceæ. These two papers are parts of a general investigation into the affinities of the lower Dicotyledons and the Monocotyledons, and contain a number of anatomical facts regarding the stem which support the view that the Dicotyledons are the primitive forms, from which the Monocotyledons have been derived.—Miss Maud D. **Haviland**: The life-history and bionomics of *Myzus ribis*, Linn. (red-currant Aphis). Among the many facts established it was shown that there are two forms of this species which differ in the minute structure of the antennæ and in the dimensions of the abdomen and wings, and are apparently correlated with the nature of the food. The species is migratory, and in summer colonises certain species of labiate and other weeds, but this change of host-plant is not obligatory, and the entire life-cycle may be passed on the red currant. There is a decline in fertility in the later summer, caused probably by lower birth-rate. This may be considered as one of the factors accounting for the frequent disappearance of the species in August and September.—Dr. C. G. **Knott**: Further note on earthquake waves and the interior of the earth. There was evidence that as the compressional and distortional seismic waves penetrated to greater depths, the distortional wave reached its maximum velocity at a less depth than the compressional wave. In other words, the rigidity showed signs of falling off in value, while the incompressibility continued to increase. The hypothesis that the earth consisted of a nucleus of non-rigid, highly compressed material encompassed by a shell possessing the properties of an elastic solid was found to fit well in with the facts, the radius of the nucleus being assumed to be four-tenths of the radius of the earth. These conclusions were based on the accurate determinations of the velocities of the seismic waves at various depths, and are in fair agreement with the views formerly advanced by Mr. R. D. Oldham.

February 3.—Dr. John Horne, president, in the chair.—Dr. J. M'L. **Thompson**: The stelar anatomy of *Platyzoma microphyllum*, R. Br. The conductive system of the stem of the Australian fern Platyzoma lies between the two extreme types of conductive systems in modern ferns. These are known as the protostele, with a solid cylinder, and the solenostele, characterised by a pithed tubular cylinder with both outer and inner phloëm and with gaps in its wall. In the Platyzoma there is the pithed cylinder, but no gaps and no inner phloëm. In the majority of specimens examined the conductive system was an unbroken and unperforated pithed cylinder, but in the smallest, and apparently youngest, specimen the conductive system was locally a protostele which was directly transformed as the stem was followed forward into the pithed cylinder without gaps in the wall and without inner phloëm. The facts were in favour of the view that the stele of Platyzoma is the result of upgrade development directly from within an original protostele.—Capt. E. W. **Shann**: The comparative anatomy of the shoulder-girdle and pectoral fin of fishes. The observations extend over a wide series of fish types, such as Rhina, Callorhynchus, Accipenser, Polypterus, and Zeus. A new nomenclature was introduced based on the divisions of the great lateral muscles which are found to be constant for any particular group of fishes. The primitive nature of the muscle system in Selachians is emphasised. Among the Holocephali certain characters foreshadow the condition which obtains in the higher vertebrates.—Sir Thos. **Muir**: Note on the determinant of the primary minors of a special set of $(n-1)$-by-n arrays.

PARIS.

Academy of Sciences, February 17.—M. Léon Guignard in the chair.—A. **Rateau**: The flow of gas at very high pressures. The classical formulæ are based on the gas law $pv=RT$, and these become inexact when p is high, several hundred atmospheres. Formulæ based on the characteristic equation $p(v-\alpha)=RT$ are developed.—J. **Drach**: The integration by quadrature of the equation $d^2y/dx^2=[\phi(x)+h]y$.—J. **Cabannes**: The diffusion of light by the molecules of the air. The proportionality predicted by the theory of Lord Rayleigh, between the luminous intensity diffused laterally by a transparent gas and the number of molecules in the illuminated volume, has been exactly verified by a method of photographic photometry devised by MM. Fabry and Buisson. Since certain ultra-violet radiations cause some complications, it is advisable, in the experimental verification, to suppress radiation with a wave-length below $0{\cdot}3\mu$.—P. **Braesco**: Precipitated amorphous silica. From experiments on the coefficient of expansion it is concluded that precipitated silica, dehydrated and heated to 600° C., is really amorphous silica, but if calcined at temperatures above 1000° C. it becomes crystalline in the form of cristobalite.—M. **Portevin**: The influence of various factors on the critical speed of tempering in carbon steels.—P. **Nicolardot** and A. **Reglade**: The estimation of zirconium. In a solution containing 20 per cent. of sulphuric acid zirconium can be quantitatively separated from iron, aluminium, and chromium by ammonium phosphate.—G. **Delépine**: The carboniferous limestone in the Lille district.—A. **Vacher**: An old direction of the Rance valley.—G. **Reboul** and L. **Dunoyer**: A rule for predicting barometric variations and its coefficient of certainty.—E. **Mathias**: Sketch of a theory of rain. The influence

of altitude.—M. **Molliard**: The production of citric acid by *Sterigmatocystis nigra*.—E. **Fauré-Frémiet** and F. **Vlès**: Are the laws of cicatrisation of wounds reducible to the general laws of growth of organisms? —A. **Lécaillon**: The reproduction and development of accidental bivoltins and of the first generation derived from them in the silkworm.

SYDNEY.

Linnean Society of New South Wales, October 30, 1918.—Prof. H. G. Chapman, president, in the chair.—Dr. R. J. **Tillyard**: The Panorpoid complex. Part ii.: The wing-trichiation and its relationship to the general scheme of venation. The hairs found upon the wings of all Holometabolous orders are classed as (1) *microtrichia*, minute hairs developed in connection with every unspecialised hypoderm cell of the wing, and (2) *macrotrichia*, larger hairs of the nature of sensillæ, only developed from special trichogen cells of large size. The arrangement of these hairs is called the wing-trichiation. The venational scheme is shown to consist of (1) *main veins* and their branches, which are preceded by tracheæ in the pupal wing; (2) true *cross-veins*, not preceded by tracheæ; and (3) the *archedictyon*, or original Palæodictyopterous meshwork formed of irregular venules, and only found complete in fossils. The Triassic fossil Archipanorpa possesses all these elements, but the archedictyon is aphantoneuric, or in process of becoming absorbed into the wing-membrane. With this fossil as a basis, the trichiation of the wings of all the orders of the complex is studied. It is shown that the most archaic forms all agree in having microtrichia all over the wing, but macrotrichia only upon the main veins and upon the membrane (the latter were originally carried upon the archedictyon, but became seated on the membrane when the meshwork disappeared), and not upon the true cross-veins. The various lines of evolution are followed out, showing a tendency in some orders to suppression of both kinds of hairs, and in others to the specialisation of the macrotrichia as scales, as in the Lepidoptera. Conclusions are drawn as to the probable phylogenies of the Orders.—Dr. H. S. H. **Wardlaw**: The relation between the fat-content and the electrical conductivity of milk. Removal of fat from milk increases the electrical conductivity. In a given sample of milk the increase of conductivity is directly proportional to the volume of fat removed. The increase of conductivity due to the removal of a given amount of fat is not the same, however, in different samples of milk. The average increase of conductivity due to the removal of 1 per cent. by volume of fat is 1·5 per cent.—J. L. **Froggatt**: A study of the external breathing apparatus of the larvæ of some Muscoid flies. It is shown that the maggots of blowflies of five species pestilent to sheep can be identified by the characters of the anterior and posterior spiracles, especially of the latter. —W. W. **Froggatt**: Notes on Australian sawflies (Fenthredinidæ). Particulars about four species are given, including a record of the death of cattle in Queensland from the abnormal habit of eating the larvæ of *Pterygophorus analis*.—R. H. **Cambage**: Notes on the native flora of New South Wales. Part x.: The Federal capital territory.

WASHINGTON, D.C.

National Academy of Sciences, December, 1918 (Proceedings, vol. iv., No. 12).—W. S. **Adams**: The absorption spectrum of the novæ. A discussion of Nova Aurigæ of 1892, Nova Persei of 1901, Nova Geminorum of 1912, and Nova Aquilæ of 1918. The displacements of the lines in all these stars are directly proportional to wave-lengths, and divide themselves into two pairs of equal amount. Of these the first pair of stars has exactly twice the displacement of the second. In the case of Nova Aquilæ there is a progressive increase in the values of the displacements of the absorption lines at successive dates. Various hypothetical explanations are discussed.—D. N. **Lehmer**: Jacobi's extension of the continued fraction algorithm. A closer study of Jacobi's expansion reveals a number of remarkable points. Six theorems are stated.—R. L. **Moore**: A characterisation of Jordan regions by properties having no reference to their boundaries. The theorem is proved. In order that a simply connected, limited, two-dimensional domain R should have a simple closed curve as its boundary, it is necessary and sufficient that R should be uniformly connected *im kleinen*.—J. A. **Harris** and F. G. **Benedict**: A biometric study of human basal metabolism. An analysis of measurements on 136 men, 103 women, and 94 new-born infants.—A. M. **Banta**: Sex and sex intergrades in Cladocera. The presentation of facts in regard to Cladocera, with the discussion of their significance with regard to sex intergrades in general, leading to the tentative conclusion that sex is always relative; and that while most individuals of whatever species are prevailingly male or prevailingly female, every individual may have something of the other sex intermingled with its prevailing sexual characters.—W. J. **Crozier**: The method of progression in Polyclads. In Turbellarians generally muscular operations analogous to those executed by the foot of Chitons and of Gastropods are essentially concerned in creeping locomotion.—R. **Ruedemann**: The phylogeny of the acorn barnacles. The derivation of an Eobalanus from a Rhinocaris-like Phyllopod is illustrated in a set of diagrams.—J. M. **Clarke**: Possible derivation of the Lepadid barnacles from the Phyllopods. So far as present knowledge extends, the metamorphoses of the Phyllopods into the two great branches of the barnacles were essentially contemporaneous.—T. W. **Richards** and W. C. **Schumb**: Refractive index and solubilities of the nitrates of lead isotopes. The difference in atomic weight of the lead (207·20 and 206·41) has no appreciable effect on the refractive index or on the molal solubility of the different samples of lead nitrate.—T. W. **Richards**, W. M. **Craig**, and J. **Sameshima**: The purification by sublimation and the analysis of gallium chloride. The method rests on the fact that gallium trichloride sublimes and distils at a low temperature, whereas the other chlorides likely to be associated with it are much less volatile.—T. W. **Richards** and S. **Boyer**: The purification of gallium by electrolysis, and the compressibility and density of gallium. The method of separating gallium from indium by means of the different solubilities of the hydroxides in caustic alkali was tested without success; much more promising results were obtained by the electrolytic method. The compressibility of solid gallium was found to be $2{\cdot}09 \times 10^{-6}$, and of liquid gallium $3{\cdot}97 \times 10^{-6}$, nearly twice as great, although its volume is less. The density of the liquid was 6·081, and of the solid 5·885.—A. G. **Mayor**: The growth-rate of Samoan coral reefs. The growth-rate of Acropora, Porites, Pocillopora, Pavona, and Psammocora are given, and the weight of limestone added per year to the upper surface of the Aua reef-flat is estimated as 805,000 lb. Other similar estimates are given.—A. van **Maanen**: The distances of six planetary nebulæ. The nebulæ N.G.C. 2302, 6720, 6804, 6905, 7008, and 7662 are examined. The parallaxes range from 0·002″ to 0·021″, and the diameters from 10,000 to 1350 astronomical units.

BOOKS RECEIVED.

What is Psycho-analysis? By Dr. I. H. Coriat. Pp. 124. (London: Kegan Paul, Trench, Trübner, and Co., Ltd., 1919.) 3*s*. 6*d*. net.

Calcolo delle Probabilità. By Prof. Guido Castelnuovo. Pp. xxiii+373. (Milano-Roma-Napoli: Società Editrice Dante Alighieri di Albrighi Segati & C., 1919.)

Ethnogeography and Archæology of the Wiyot Territory. By L. L. Loud. Vol. xiv., No. 3. (University of California Publications in American Archæology and Ethnology.) Pp. 221–436+plates 21. (Berkeley: University of California Press, 1918.)

Chimica delle Sostanze Explosive. By Prof. Michele Giua. Pp. xvi+556. (Milano: Ulrico Hoepli, 1919.) 28 lire.

Sanitation Practically Applied. By Dr. Harold Bacon Wood. Pp. vi+473. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 13*s*. 6*d*. net.

The Game Birds of California. Contribution from the University of California Museum of Vertebrate Zoology. By Joseph Grinnell, Harold Child Bryant, and Tracy Irwin Storer. Pp. x+642+16 coloured plates. (Berkeley: University of California Press, 1918.) 6 dollars net.

The Secret of Personality. The Problem of Man's Personal Life as Viewed in the Light of an Hypothesis of Man's Religious Faith. By Dr. G. T. Ladd. Pp. ix+287. (London: Longmans, Green, and Co., 1918.) 7*s*. 6*d*. net.

Osmotic Pressure. By Prof. Alexander Findlay. Second edition. (Monographs on Inorganic and Physical Chemistry.) Pp. xi+116. (London: Longmans, Green, and Co., 1919.) 6*s*. net.

An Advanced Course in Quantitative Analysis. With explanatory notes. By Prof. Henry Fay. Pp. vi+111. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 6*s*. net.

A Systematic Course of Qualitative Chemical Analysis of Inorganic and Organic Substances. With explanatory notes. By Prof. Henry W. Schimpf. Third edition, revised. Pp. ix+187. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 7*s*. net.

Differential Calculus. By Prof. H. B. Phillips. Pp. v+194. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) 9*s*. 6*d*. net.

Empirical Formulas. By Prof. Theodore R. Running. (Mathematical Monographs, No. 19.) Pp. 144. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 7*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 6.

ROYAL SOCIETY, at 4.30.—L. F. Richardson: (1) Atmospheric Stirring Measured by Precipitation; (2) Measurement of Water in Clouds.

ROYAL SOCIETY OF ARTS, at 4.30.—W. R. Gourlay: The Need for a History of Bengal.

LINNEAN SOCIETY, at 5.—Dr. Harold Wager: The Colour-sense of Wasps.—F. Lewis: Notes on a Visit to Kunadiparawitta Mountain, Ceylon, with List of the Plants observed and their Altitudinal Distribution.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

CHILD-STUDY SOCIETY, at 6.—Miss S. Walker: The Training of Teachers from the Child-Study Standpoint.

CHEMICAL SOCIETY, at 8.—Prof. J. W. Nicholson: Emission Spectra and Atomic Structure.

FRIDAY, MARCH 7.

ROYAL INSTITUTION, at 5.30.—Prof. H. C. H. Carpenter: The Hardening of Steel.

SATURDAY, MARCH 8.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—Capt. G. P. Thomson: The Dynamics of Flying

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. W. A. Bone: Coal and its Conservation.

SOCIETY OF ENGINEERS, at 5.30.—A. S. E. Ackermann: Experiments with Clay in its Relation to Piles.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Major J. B. Noel: The Eastern Approaches to Mt. Everest.

TUESDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Prof. H. Maxwell Lefroy: Insect Problems.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 3, with Prehistoric Society of East Anglia.—R. S. Smith: Presidential Address—Foreign Relations in the Neolithic Period.—At 5.15.—S. H. Warren: The Dating of Surface Flint Implements and the Evidence of the Submerged Peat Surfaces.—M. Léon Coutil: Note on an Allée Couverte Discovered in the Course of making Trenches for the Defence of Paris.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—J. Caldwell and H. B. Sayers: Electric Welding Developments in Great Britain and the United States of America.—W. S. Abell: Experiments on the Application of Electric Welding to Large Structures.—J. R. Smith: The Application of Electric Welding in Ship Construction and Repairs.

WEDNESDAY, MARCH 12.

ROYAL SOCIETY OF ARTS, at 4.30.—W. L. Lorkin: Electric Welding and its Applications.

GEOLOGICAL SOCIETY, at 5.30.—E. H. Pascoe: The Early History of the Indus, Brahmaputra, and Ganges.

ROYAL AERONAUTICAL SOCIETY, at 8.—H. Levy: From Model to Full Scale in Aeronautics.

THURSDAY, MARCH 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Dr. A. D. Waller: Concerning Emotive Phenomena. III.: The Influence of Drugs upon the Electrical Conductivity of the Palm of the Hand.—Dr. W. L. Balls: The Existence of Daily Growth-rings in the Cell Wall of Cotton Hairs.

ROYAL SOCIETY OF ARTS, at 4.30.—D. T. Chadwick: The Report of the Indian Industrial Commission.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

OPTICAL SOCIETY at 7.—Major C. W. Gamble: Some Photographic Apparatus used in Aerial Photography.

FRIDAY, MARCH 14.

PHYSICAL SOCIETY, at 5.—C. C. Paterson and Dr. Norman Campbell: Some Characteristics of the Spark Discharge, and its Effect in Igniting Explosive Mixtures.

ROYAL INSTITUTION, at 5.30.—Prof. A. Keith: The Organ of Hearing from a New Point of View.

SATURDAY, MARCH 15.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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THURSDAY, MARCH 13, 1919.

BIOLOGICAL PROBLEMS.

Medical Contributions to the Study of Evolution. By Prof. J. G. Adami. Pp. xviii+372. (London: Duckworth and Co., 1918.) Price 18s. net.

A BOOK attempting to throw light upon biological problems from a new point of view is always likely to be interesting, and we therefore welcome Prof. Adami's work. Undoubtedly much controversial matter is introduced, but a point of view that sometimes challenges what is too often taken for granted is, at any rate, stimulating. Although in his letter quoted in the appendix Sir Ray Lankester protests that certain experiments are well known to him, we venture to think that many of the facts brought forward are unfamiliar to biologists in general.

The book is divided into three parts, with two appendices. Parts i. and ii. will be the most interesting to the general biologist. The reprinted papers in the latter parts of the book, however, entail a great deal of repetition, while the style is somewhat cumbrous and involved. The preparation of the book in war-time may be the excuse for leaving many things as they were originally written, later work being often referred to in footnotes, but the actual matter could, with advantage, have been condensed into a much shorter book without loss of clearness. A less unwieldy book, too, might have been published at a lower price, for we cannot say that the amount asked errs on the side of cheapness.

The first part of the book consists of the Croonian Lectures for 1917 on "Adaptation and Disease." Starting with an introductory chapter upon variation and adaptation as the basis of evolution, we get two chapters upon variation and adaptation in the bacteria, followed by one upon the corresponding adaptations in higher animals to pathogenic agencies. The next chapter deals with the inheritance of acquired conditions in the higher mammals, quoting Carrière's work with tuberculin, and Stockdale's experiments upon the effects of alcohol vapour, to show that influences acting upon the parents may affect the offspring in the two succeeding generations. Kammerer's work upon *Salamandra maculosa* is also quoted. Chap. vi. deals with the physico-chemical basis of the subject, and the author brings forward a conception of the constitution of living matter based on the structure of the proteins. He recalls the fact that in organic compounds generally the mere position of a radical profoundly alters the properties of the compound, and shows that with a complex molecule such alterations may lead to a multiplicity of different new properties. From this he proceeds to the elaboration of a physico-chemical conception of growth. The final chapter is devoted to a recapitulation and review of the conclusions reached.

It is a pity that in such a work there is evinced a spirit of animosity to certain leading biologists. We may suspect the author of setting up a figment for demolition in ascribing to Bateson the belief that evolution occurs solely by the loss of factors. We think also that nothing of importance is gained by the republication of the controversy in Appendix ii., the tone of which reflects credit upon neither party.

There are a few misprints and inaccuracies requiring attention. On p. 18 Limulus is stated to be "no crab, but an Arthropod"; this should obviously be "Arachnid." The "intestinal amœbæ" of Musgrave and Clegg referred to upon p. 46 are almost certainly coprozoic forms and not true parasites; nevertheless, the adaptability to unusual forms of diet is interesting. The allusion upon p. 240 to Loeb's work on chemical fertilisation is out of date and should not have been left as it stands. In the first place, it has been shown conclusively that development is not initiated by mere changes in tonicity. Moreover, though active nuclear changes and cell division may be set up by artificial means, they do not always continue, but under certain conditions the process may cease when the four- or eight-celled stage has been reached, leaving the resting cells susceptible each of fertilisation by a spermatozoon.

The main value of the book consists in the insistence upon the physico-chemical constitution of living matter, and we welcome particularly the author's onslaught upon Weismann's cut-and-dried morphological conceptions of heredity. Nevertheless, it should be borne in mind that the work of Conklin and others shows the existence of structure even in the egg. It may be pointed out, however, that in chap. vii. we are somewhat inconsistently presented with some purely morphological diagrams illustrative of the side-chain theory. It is evident that a physico-chemical explanation of such a theory must depend upon unsatisfied or unsaturated linkages, which would be just as easy to represent and would convey a truer picture of the mechanism of protoplasmic reaction.

On the whole, the book may be commended to the attention of the general biologist.

GENETICS FOR THE BOTANIST.

Plant Genetics. By J. M. Coulter and M. C. Coulter. Pp. ix+214. (Chicago: University of Chicago Press; London: Cambridge University Press, 1918.) Price 1.50 dollars net.

THIS little book is one written by botanists for botanists. The authors state in their preface that it is designed especially for the undergraduate student in botany who wishes to obtain some knowledge of what is being done in genetics without desiring to specialise in the subject. They have attempted, so far as possible, to present an exposition of Mendelian, or neo-Mendelian, phenomena illustrated by examples from the vegetable world alone. As to the advisability of this there is likely to be some difference of opinion, for many hold, and with some justice, that one of the instructive features of genetics for the

student lies in the numerous close parallels to be found between animals and plants in respect of heredity. A discovery in an animal may at any moment throw a flood of light upon puzzling phenomena in plants, and the converse is equally true. The genetics of plants and animals are so closely interwoven that an attempt to treat of one without the other necessarily leads to a sense of incompleteness. At the same time the unity of some of the fundamental phenomena of life in the vegetable and animal kingdoms—a most valuable lesson for the young student—is apt to be lost sight of. Even the authors have had to confess that the animal cannot be entirely excluded, for they had perforce to bring in Morgan's Drosophila and Castle's rats. Nevertheless, they have succeeded in illustrating most of the important phenomena from plants alone, and the work will be of service not only to the young botanist, but perhaps even more so to the zoologist, who is apt to be hazy with regard to the special features that plants exhibit.

We venture to hope that in the next edition the authors will enter rather more fully into the phenomena of the fertilisation of plants; for it is here that the zoologist so often encounters a stumbling-block. The chapter on endosperm inheritance is a distinct advance upon the usual text-book treatment; but we would suggest, for the sake of the zoologist, a more detailed account of the manner in which the egg is derived from the megaspore, and of the fate of the nuclei of the pollen-grain. Apogamy, too, might be treated more liberally, with reference made to the important researches of Ostenfeld and Rosenberg. Apart from its intrinsic value, the work of these observers has a peculiar interest in connection with Mendel's own work on Hieracium. On the whole, the authors have given a clear and lucid presentation of genetic phenomena in plants, and one that should prove useful to the class of student for whom it was designed. We hope it may fall into the hands of many students and teachers in this country, where the study of plant genetics is far less widespread than it should be. It is high time it became an integral part of the botanical course at every university, and the authors of this little book have certainly demonstrated that this can easily be done without unduly trespassing upon the field of the zoologist.

For the benefit of the English student, it should be stated that although the authors have naturally drawn upon American material in illustration of the various phenomena, it does not follow that these were necessarily discovered on the other side of the Atlantic. They state, for instance, that "the classic illustration of coupled characters was brought to light by Emerson during breeding experiments with corn." If there is a classic example here, it should surely be Bateson and Punnett's sweet peas, where the phenomena were first discovered, and the peculiarities of this type of inheritance first worked out. The authors confess to some inexactness in dealing with details, urging the excuse of pedagogical necessity. Still there are few statements definitely misleading. But the account of Mendel's peas on p. 37 looks as though the authors had fallen into the familiar trap that has snared so many an elementary student, forgetting that the seed characters used belong to a generation subsequent to that of the plant on which they are borne.

The book is of a handy, small size for a student's pocket, well printed, and illustrated by a number of simple diagrams.

NATURAL HISTORY IN THE NEW WORLD.

(1) *Far Away and Long Ago. A History of My Early Life.* By W. H. Hudson. Pp. xii + 332. (London: J. M. Dent and Sons, Ltd., 1918.) Price 15s. net.

(2) *Jungle Peace.* By William Beebe. Pp. 297. (New York: Henry Holt and Co., 1918.)

(3) *The Ledge on Bald Face.* By Major C. G. D. Roberts. Pp. 255. (London: Ward, Lock, and Co., Ltd., 1918.) Price 5s. net.

(1) THERE is much of the old-time naturalist in "Far Away and Long Ago," by that G.O.M. of natural history, Mr. W. H. Hudson. It is a simple story, the recollections of his early life on the savannahs of the Argentine. We can imagine the *estancia*, with its poplars and willows, and with its flowery orchard lying isolated on the lonely downs. The whole was protected by a broad moat, and must have been a veritable oasis to woodland birds in what otherwise was to them an inhospitable land. Here Hudson made friends of birds, beasts, and trees, each one to him acquiring its own individuality: the cowbird parasitical like the cuckoo; the red willow, with its pair of tyrant birds, ever ready to attack the wandering hawk; green paroquets; peaches in blossom, loveliest of sights, and a proper bandstand for flocks of singers. The armadillo and the opossum were burrowers, the latter, with its children, giving hospitality to pit vipers, most malignant of snakes. Here and there, on the plains, were *viscacha* villages, immense badger-like earths of a large rodent now getting extinct. The house was an old one, a relic of the early Spanish settlers, tillers of the ground, later driven to the herdsman or *guacho* life. As to the fenman the fens are the most beautiful of all lands, so to Hudson his pampas colours of yellow to rust, the latter produced by giant thistles, are beyond compare, their serenity disturbed only by the occasional *pampero* (hurricane) from the Southern Ocean. He was clearly a lonely boy, and it is not difficult to see how he made friends with Nature.

Hudson brings us back to Rosas, whom he describes as the bloodiest, the most original-minded, and the greatest of the dictators of South America. Rosas was in origin a *guacho*, and he had the cruelty and sardonic humour of the class from which he sprang. He brought peace to the prairies, and in his time came many of

the British settlers, who are now merging into a new race. The old settler neighbours are described with their establishments and estates, which are clearly best remembered for their rheas, feral pigs, or more frequently their birds and frog-infested lakes. Old as Hudson is, he still remains a boy, projecting himself into bird, beast, and plant. We imagine him as full of happiness and peace, and we trust he may continue so for many years. Try as we may, we cannot speak of him impersonally after we have read his book.

(2) "Jungle Peace" is altogether a contrast, the work of a modern, professional naturalist, with excellent descriptions and bright writing, but without the delightful unconsciousness of self belonging to the old-time author. Perhaps, in these days, scientific education has to some degree killed out the soul for Nature, and we may never see it again in its old form in the professional man of science, in whom the wonders of heredity have crushed out interest in simple habits and psychology. The book is the description of the establishment of a tropical research station in British Guiana, the wish being to study birds, beasts, and insects in their natural environment. The site chosen was an old house in the jungle near the mouth of the Essequibo, and the quite vivid descriptions show that it was well chosen and suitable for researches on the beasts of the little-known continent of South America. The jungle came right up to the doors of the house, and a trail was cut through it to form a collecting ground. The fauna was evidently of extraordinary richness.

(3) Our third work is in a different category still, the latest work of a popular author of the North-west, a land famed for its inimitable wilds and its few, but conspicuous, beasts. To quote R. W. Service,

Big mountains heaved to heaven, which the blinding sunsets blazon,
Black canyons where the rapids rip and roar.

Major Roberts is a man to follow, for he is never dull, and is true to Nature in man, bird, and beast.

OUR BOOKSHELF.

Man's Redemption of Man. By Sir William Osler. Third edition. Pp. 63. (London: Constable and Co., Ltd., 1918.) Price 7*d*. net.

THIS "lay sermon" is a delightful piece of writing; good thoughts in good English; a little Magnificat for anæsthetics, antiseptics, preventive medicine, and other great results of the work of the medical sciences; the author has the secret of sympathy, and the art of making you think of what he is saying. The war has shown us further instances of the value of medical discoveries than we had in 1910; but that fact does not impair the wisdom and the pleasantness of the discourse. There is one passage in it which is exemplary; Sir William challenges the anti-vaccinationists with the old argument, which they cannot beat:—

"I would like to issue a Mount-Carmel-like challenge to any ten unvaccinated priests of Baal. I will take ten selected vaccinated persons, and help in the next severe epidemic, with ten selected unvaccinated persons (if available!). I should choose three Members of Parliament, three anti-vaccination doctors, if they could be found, and four anti-vaccination propagandists. And I will make this promise—neither to jeer nor to gibe when they catch the disease, but to look after them as brothers; and for the three or four who are certain to die I will try to arrange the funerals with all the pomp and ceremony of an anti-vaccination demonstration."

Galileo. By W. W. Bryant. ("Pioneers of Progress," Men of Science Series.) Pp. 64 + portrait. (London: Society for Promoting Christian Knowledge, 1918.) Price 2*s*. net.

BORN in the same year as Shakespeare, Galileo Galilei shared with his contemporary that philosophic outlook, that felicity of diction, and that elegant style which have contributed to the fame of both. Prof. Playfair has said that in reading Galileo's "Dialogues" one feels oneself carried back to the period when the telescope was first directed to the heavens, and when the earth's motion, with its train of consequences, was proved for the first time. Mr. Bryant has given a careful account of the life of the great natural philosopher, whose first appointment was a professorship of mathematics with a salary of about five shillings a week. Galileo was, however, both a discoverer and an inventor, and started a workshop in his own house, in which he employed a staff of mechanics under his personal supervision to make his geometrical and military compass, his hydrostatic balance, his magnets and telescopes. He ground all his lenses himself until his sight failed. The story of his conflict with the Jesuits as to the Copernican doctrine, and of his examination before the Inquisition, is retold in an interesting but unbiassed manner. His sufferings hastened the triumph of the doctrines which he upheld, and have ensured his enduring fame. H. S. A.

Surface Tension and Surface Energy and their Influence on Chemical Phenomena. By Dr. R. S. Willows and E. Hatschek. Second edition. Pp. viii + 115. (London: J. and A. Churchill, 1919.) Price 4*s*. 6*d*. net.

THE first edition of this useful volume was reviewed in the issue of NATURE for July 8, 1915 (vol. xcv., p. 506), when the scope of the book was described. The present edition has been enlarged by the addition of a chapter on some important complex phenomena, and it also now includes, among other additions, Mr. Whittaker's work on the connection between surface energy and internal latent heat; a summary of recent theories on the structure and properties of metals, in which the surface energy of the intercrystalline layer plays an important part; Dr. A. Ferguson's equation connecting surface tension and absolute temperature, and paragraphs on adsorption.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Directorship of the Natural History Museum.

A RETROSPECT of fifteen to twenty years will show the effect in action of the proposed appointment of a Civil Servant to be director of the Natural History Museum.

The Science Museum adjacent had then been handed over to the direction of a Civil Service official, acting, apparently, on secret instructions that the collection of machinery and models initiated by Bennet Woodcroft was too great an expense for this country to maintain, although something less than one of our numerous Lord Chancellors; and a "ca' canny" policy was to be adopted until the director had qualified for the higher scale, when the museum was to be closed.

But the science collection was saved by a miracle from dispersal, and a competent man appointed to direct in the late Mr. Last. Too late, unfortunately, for him to secure such trophies as a broad-gauge express locomotive or the paddle-engines of the *Great Eastern,* to be had as a gift, and erected outside in the open if there were no funds to house them.

The historical collection was the envy of Germany, which would have bid for it, if the chance had come, to serve as the nucleus of the magnificent museum in imitation at Munich, on which no expense was spared to make it perfect and complete.

Prof. Klein was on a visit of inspection at the time to collect ideas for the projected Munich Museum, and I felt humiliated for England that he should glimpse our official mentality, and hear the low opinion held of the value of our own work, as I accompanied him round.

Quieta non movere is the motto of the old Government official. But the first act of Mr. Last's appointment was to set the collection of models at work by compressed air.

The collection grew out of the old Patent Museum, under the care of Bennet Woodcroft, encouraged by Cole, and housed in the Brompton "Boilers," Thackeray's name for the corrugated-iron sheds.

It is melancholy to reflect on the glorious chances lost by the niggardly policy lasting up to the war. The office of Master-General of the Ordnance had been re-established, entrusted with our military preparedness; and why not that of the Master-General of the Mechanicks, as Sir Samuel Morland was, for title of the director, chosen as an enthusiast, always on the look-out for additions?

But there has been no director of the Science Museum since Mr. Last. The Government official is suspicious of the competent man. G. GREENHILL.

1 Staple Inn, W.C.1, March 8.

Absorption of Gases by Charcoal.

OF late years much attention has been given to the remarkable power of charcoal to absorb gases of all kinds, and during the war extensive use has been made of this property in the construction of masks for removing noxious gases from the air inhaled by the wearer. As a matter of justice to the memory of a man whose interesting work in the chemistry of vegetable products is apt to be forgotten, I should like to remind readers of NATURE that the first practical application of charcoal for such purposes was made by Dr. John Stenhouse, lecturer in chemistry at St. Bartholomew's Hospital. In 1854 Stenhouse devised a charcoal respirator consisting of a perforated zinc case filled with granular wood charcoal, and adapted to fit over the mouth and nose. Respirators of this kind were in use by nurses and dressers in St. Bartholomew's, and, I believe, some other hospitals, down to the time when Lister's antiseptic system rendered such protection from the offensive emanations of sores unnecessary. When I worked in Stenhouse's private laboratory in 1862–63 he gave me one of these respirators, and I made use of it long afterwards with great advantage when experimenting on the gases from *aqua regia* and other irritating substances.

Stenhouse further succeeded in inducing the authorities of the City of London to make use of charcoal as a deodorant of the gases liable to escape from the gullies in the streets, in which application it was quite satisfactory so long as it was kept dry. The difficulty of excluding water and mud from the trays on which the charcoal was placed led, after a few years, to the abandonment of the system in the streets. The letter addressed by Stenhouse to the Lord Mayor in February, 1860, on the subject was reviewed in the *Chemical News* (vol. iii., p. 78). In the same journal (vol. xxv., p. 239) there is a letter from Stenhouse dated May, 1872, in which he refers to his respirators as then coming into use in chemical laboratories. WILLIAM A. TILDEN.

February 28.

The Profession of Chemistry.

THE admirable article under the above title in the issue of NATURE for February 27 will be welcomed by all who cherish the belief that active development of chemical study is vital to the welfare of the State, and modestly hope that public recognition of this fact, so long deferred, may be acknowledged before it is too late. I am convinced, however, that this recognition will not be accorded until the question of nomenclature, to which you refer, has been arranged satisfactorily.

Schools and universities are not the only seats of learning. The street is one; its influence is persistent and universal, for practically all sections of the community, excepting Outer Hebridesians and Scotch crofters, come, sooner or later, under the spell of its suggestion. Yet every day, from childhood to the grave, we are told by the street that a chemist is identical with a pharmacist, and principally occupied in dispensing medicine and in the sale of toilet requisites. Is it surprising that the public is still unaware of the basic fact that the principles of chemistry lie at the foundation of our great national industries and of all the forms which life itself assumes?

In the exercise of his craft the baker practises daily some curious operations in organic chemistry which are not even yet understood by organic chemists themselves. Supposing that some enterprising baker early in the nineteenth century had called himself a "chemist and baker," that the idea had been embraced by the whole body of bakers, and that the public, in purchasing jam-tarts or cake, had become accustomed to passing under the sign of the "Chemist and Baker," would it not be excusable if the much abused public hazily associated confectionery with argon, T.N.T., or British dyes?

The only remedy for the present situation is courteously to approach the Pharmaceutical Society and endeavour to establish a friendly arrangement, in conformity with which the members of that body, who are now variously denominated "chemist," "pharmacist," and "druggist," would content themselves

with two of these names, leaving the first word for the definition of persons engaged more obviously in the extension of chemical knowledge or the application of chemical principles.

Pharmacy is an honourable occupation, and I cannot believe that the pharmacist would lose dignity or status by the change. Comparatively few pharmacists are chemists in the modern sense, and it is well known that in other great countries this confusion of titles does not prevail; in fact, this is one of the few points on which we are at variance with our Allies, whilst they are in complete harmony with the Hun.

M. O. FORSTER.

Savage Club, W.C.2, March 4.

Graphic Methods in Nautical Astronomy.

IN the issue of NATURE published on October 24 last (vol. cii., p. 155) there appeared an account of an ingenious chart devised by Mr. G. W. Littlehales, of the United States Hydrographic Department, for dealing rapidly with certain problems in nautical astronomy which involve the solution of a spherical triangle when the three sides, or the two sides and the included angle, are known. The article is entitled "A New Graphic Method in Nautical Astronomy," but it would appear that the idea has been familiar in France for more than five-and-twenty years. The possibility of constructing a chart like that made by Mr. G. W. Littlehales was demonstrated by Maurice d'Ocagne so long ago as 1891 in his work "Nomographie: les calculs usuels effectués au moyen des abaques," p. 84, and an abacus devised by him on these lines was described in W. Dyck's "Katalog mathematischer und mathematisch-physikalischer Modelle, Apparate und Instrumente," published in 1892, p. 163. A figure of the chart can be found in a paper by d'Ocagne which appeared in the *Journal de l'Ecole Polytechnique* (second series, 4th cahier, 1898, p. 224), and also in his "Traité de Nomographie," 1899, p. 328. In a modified form the chart was employed by E. Collignon in 1898 (see his "Note sur la détermination de l'heure du passage du soleil dans un plan vertical," *Journal de l'Ecole Polytechnique, loc. cit.*, pp. 123–35).

As drawn by Mr. Littlehales the chart occupies a square of 15-in. side. From 5° to 175° it is graduated to single degrees, and over a large part of the scale can be read by estimation to 6′. Although the printing of two copies obtained from Mr. Potter, agent for Admiralty charts, Minories, London (price 2s. 6d. each), is roughly executed, the chart is capable of doing good service in providing a rapid means of checking the results of calculation. The particular cases in the solution of spherical triangles it is designed to deal with, frequently occur in the reduction of crystal measurements, and the use of the chart can be confidently recommended to crystallographers.

A. HUTCHINSON.

The Mineralogical Laboratory, Cambridge, February 26.

Curious Markings on Chalk.

IN NATURE of March 6 there appeared a short notice of a piece of chalk said to be carved to represent a mammoth. This specimen was described and figured by Mr. Reid Moir in the February issue of *Man*, p. 17, pl. B. Examination of the figures there given shows that the object is nothing more than a somewhat imperfect natural cast of a chamber of the shell of an Ammonite. It is significant that in some parts of the country where such casts are not uncommon the quarrymen call them "pigs."

CHAS. W. ANDREWS.

British Museum (Natural History), March 8.

Globular Clusters, Cepheid Variables, and Radiation.

(1) THE determination of the past duration of solar radiation, and, consequently, the problem of the age of the inhabitable earth, imposes upon theories of radiation a difficulty the magnitude and fundamental importance of which appear to be too infrequently considered. The difference in the time-scales derived from the gravitational theory of solar energy and from geological and astronomical observation is not one of a few per cent. (or less) of the basic quantities involved, as is generally the case with the discrepancies that have led to conspicuous modifications of radiation theories; the discrepancy is rather a matter of a hundred to one, or even of a thousand or more to one. A more glaring disagreement could scarcely be imagined between a generally accepted and thoroughly workable theory on one hand, and, on the other, a mass of observation now too extensive and varied to be denied and some equally formidable physical laws.

Until recently the arguments for a long time-scale have been mostly geological and biological, and they have not been strongly insisted upon; imperfections in the geological records have been held to minimise the disagreement with the Helmholtz-Kelvin contraction theory of the sun. Similarly, the arguments for the short time-scale have not been too convincing, to some geologists at least, because of the promising possibility of finding new sources of energy or other escape from the physical theory. Hence on both sides of the question there has been a feeling of uncertainty relative to the validity and finality of opposing arguments, and on neither side has the discrepancy been strongly emphasised as a critical point for theories of radiation and the structure of matter.

(2) In recent volumes of NATURE the limited possibilities of the gravitational contraction of the sun in the problem of the age of the earth have been argued anew by Lindemann,[1] Jeans,[2] and Eddington.[3] The energy of contraction, as is well known, is essentially self-regulating for gaseous stars, and its evaluation is a clear and straightforward process. The available supplementary sources of energy seem incompetent; the heat of chemical combinations, an assumed increase in the specific heat, any definitely recognised atomic supply—all such as these appear quite insufficient to affect the problem. In fact, Jeans has shown by a calculation, remarkable both for its brevity and directness, that the total capacity of all electrical sources of energy (including the chemical and radio-active) must be comparatively small. He concludes: "It accordingly looks as though the Helmholtz contraction will provide much more energy than any other source, and we must apparently adjust our views to the time-scale set by the contraction theory."

Eddington[4] has pointed out important objections to the rather bizarre conception of obtaining great stores of energy through the gradual annihilation of matter, positive and negative electrons occasionally annulling each other.

Hence, unless we question, in some manner wholly new, the strict application of the gravitational theory, we may feel now more certain than ever that the sun could have radiated at the present rate for only a few million years.

(3) The main purpose of this note is to remark that recent developments in stellar astronomy make it unnecessary to rely on geological evidence alone for the proof of a vastly longer duration of solar radiation than the gravitational hypothesis admits. Thus the argument need no longer involve only the indefinite opposing of the tenets and conclusions of one science

1 Vol. xcv., pp. 203, 372 (1915). 2 Vol. xcix., p. 444 (1917).
3 Vol. xcix., p. 445 (1917).
4 *Loc. cit.* and Monthly Notices, vol. lxxvii., p. 611 (1917).

against those of another. Each of the lines of astrophysical evidence sketched below supports the existence of a long time-scale; taken altogether, I believe they may be considered (in agreement with geological results) as very strong evidence that the quantity of energy radiated by the sun has not changed appreciably during more than a thousand million years.[5]

(*a*) Studies of globular clusters and of faint stars now indicate a diameter of the known galactic system of scarcely less than a half-million light-years.[6] Average stellar velocities appear to be less than 10^{-4} times the velocity of light. Accordingly, a single oscillation-period of a star, or of a group of stars, in the galactic system is probably not less than 10^{10} years—nearly a thousand times longer than the interval during which the Helmholtz-Kelvin contraction, according to current interpretation, can sustain present solar radiation—and one oscillation-period cannot be taken to represent a very large part of the history of a star's evolution.[7] We have no evidence of clusters the stars of which are all at the beginning or end of their luminous careers; stars are not evolving from invisibility continuously and in great numbers in any part of the galactic system that we have studied. In other words, the introduction of a vastly greater linear scale into the sidereal system indicates the necessity for a corresponding increase in time.

(*b*) Compared with the most distant globular clusters known, the brighter ones are some 200,000 light-years nearer the earth, and, therefore, in our records their stars are 200,000 years older.[8] Such an interval of time would more than suffice, on the basis of recognised sources of energy, for the whole development (through luminous stages) of a giant star, according to calculations by Eddington.[9] There is, however, no evidence of differences of age for near and distant clusters, either in the numbers, colours, and distribution, or other properties of giant stars open to investigation. Indeed, the distribution and motion of globular clusters with respect to the galactic system, their isolation in space, and the evidence of states of internal equilibrium practically negative the possibility of short life for their hundreds of giant stars.

(*c*) The luminosity-period curve of Cepheid variation[10] uniquely relates the period of pulsation of a giant Cepheid variable to its absolute brightness, the individual deviations from the mean curve averaging less than the observational uncertainties. The shorter the period of a Cepheid, the less is its absolute brightness. But for any given star this brightness does not decrease during the giant stage, according to theoretical results of Eddington[11] and Jeans[12]; apparently, therefore, the total life of the variation of a Cepheid passes without appreciable shortening of period.[13] Since period $\propto$ density$^{-\frac{1}{2}}$ according to the hypothesis that some type of pulsation is the cause of Cepheid phenomena, the variability passes also without appreciable change in mean density, and therefore gravitational contraction in these giant stars makes no progress during the whole interval of time that Cepheid variation is effective. This interval of time, however, must be exceedingly long; no certain non-periodic diminution either in amplitude or period has ever been detected in a typical Cepheid. Disregarding both the period-luminosity curve and the mathematical theory of a gaseous giant star, we still have, as Eddington has also noticed,[14] an indication from individual Cepheids that the time-scale is long. A study of δ Cephei[15] for 125 years and of ζ Geminorum for 75 years shows no measurable change in period—no change, therefore, either in mean density or in volume, and the observations are precise enough to justify the conclusion that gravitational theory, as ordinarily interpreted, accounts for less than a thousandth of the energy that is radiated away.

To the three groups of argument outlined above may be added a number of quantitatively less definite results. The clearest are:—(*d*) Evidence similar to (*c*) from the study of the periods of eclipsing binaries, and (*e*) the tidal development of our planetary system.

None of these results goes farther numerically than to indicate lower limits to the time-scale. The evidence of contraction is essentially all negative, and the duration of stellar radiation may be anything greater than the lower limit. So far as we now know, it is just as probably a million as a hundred times the value provided by known sources of energy.

(4) It should be remarked that the geological evidence has become much stronger in recent years. The exhaustive summarisation by Barrell[16] of methods of measuring earth-age from the radio-activity of rhythms in sedimentation and erosion, salinity of the oceans, and biological evolution leaves little ground for a short time-scale in geological history. The oldest sedimentary rocks appear to be about 1,500,000,000 years old, and before their formation unknown ages elapsed. Independently of the extrapolated results from radio-activity in terrestrial rocks, Schuchert[17] derives from studies in historical geology an age of some 800,000,000 years for the earliest Archæozoic formations.

(5) In computing the total energy radiated by the sun, the custom naturally has been to multiply the amount measured for unit area at the earth's surface by the total superficial area of the sphere the centre of which is at the sun and the radius of which is the earth's mean distance. It may be well to point out, as a possible contribution to the solution of the great discrepancy discussed above, that, however natural the customary procedure may be, nevertheless this integration over the whole sphere involves an assumption that may be not only unnecessary, but possibly even unwarranted in the present state of our knowledge of the theories and phenomena of radiation; and if solar and stellar radiation is not uniformly propagated in all directions—if in any way it is facilitated by the presence of surrounding bodies—then the controversy between the short and long time-scales approaches a solution that does not violate the basic results of either line of reasoning.

If, following Sir J. J. Thomson,[18] we actually materialise the Faraday lines of electric force and adopt a corpuscular theory of radiation, already we may have good reason to question the assumed independence of radiation and direction. The ordinary undulatory theory, to be sure, requires a continuity in the electromagnetic field, but continuity is by no means a necessary postulate in the analysis of Maxwell's equations.

A special and limiting condition, along the line of the present suggestion, would require that the radiation from an isolated source should be wholly confined to the solid angles subtended by surrounding matter. Dr.

[5] Cf. general discussion in Publ. Ast. Soc. Pac., vol. xxx., p. 283 (1918).
[6] Mt. Wilson Contr., No. 157 (1918).
[7] Cf. Charlier, *Observatory*, vol. xl., p. 390 (1917); Jeans, *ibid.*, p. 406. A much smaller stellar system was considered by Charlier and Jeans than is now under consideration.
[8] Publ. Ast. Soc. Pac., vol. xxx., p. 54 (1918); Mt. Wilson Contr., No. 157, p. 14 (1918).
[9] Monthly Notices, vol. lxxvii., pp. 610, 612 (1917).
[10] Mt. Wilson Contr., No. 151, p. 16 (1917).
[11] NATURE, vol. xcix., p. 308 (1917); Monthly Notices, vol. lxxvii., pp. 16, 506 (1916, 1917).
[12] Monthly Notices, vol. lxxviii., p. 36 (1917).
[13] Mt. Wilson Contr., No. 154, p. 6 (1917).
[14] *Observatory*, vol. xli., p. 379 (1918).
[15] Cf. analysis by Luizet, Annales de l'Université de Lyon, N.S., i. fascicule 33 (1912).
[16] Bull. Geol. Soc. of Amer., vol. xxviii., pp. 745-904 (1917).
[17] "The Evolution of the Earth and its Inhabitants" (New Haven, 1918), chap. ii.
[18] "Electricity and Matter" (London 1904), and elsewhere.

Bateman's[19] corpuscular theory of the structure of the electromagnetic field is not out of harmony with this view, and, moreover, his hypothesis has the distinct advantage of accounting for wave-motion as a special case, thus apparently pointing to a method of avoiding those difficulties with interference and diffraction that usually affect corpuscular theories. If we accept the rather preferable "solid angle" hypothesis instead of a less restricted type of non-uniform radiation (such, for instance, as the "specked" wave-front[20]), it is not certain just what difficulties might arise in regard to the ultimate trend of planetary temperatures. But certainly the great majority of recorded sidereal phenomena would be unaffected, whether the "solid angle" interpretation is adopted or merely one which requires that radiation should be much restricted outside the solid angle.

In addition to the possibility of accounting immediately for the large discrepancy in the duration of solar and stellar radiation, there would be other decided advantages in a hypothesis of this kind.

First, we should no longer be confronted with the tragic and almost incomprehensible "waste" of stellar energy. On the ordinary continuity theory, all the sun's radiation, except the one-millionth of 1 per cent. that falls upon planets or known stars,[21] penetrates indefinitely far beyond the regions where now we observe material bodies; and we recognise no reasonable mechanism for its recovery or rematerialisation.

Secondly, we should not have to call upon some unknown source of energy to account for the simplest problems of stellar radiation; the otherwise happy accordances now existing between astronomical observation and gravitational theories of gaseous bodies would emerge from the shadow of this great doubt.

Thirdly, among others of less obvious connection, the following outstanding stellar phenomena might find partial or complete explanation:—(*a*) The remarkable decrease of redness with brightness for the giant stars in globular clusters[22]; (*b*) the relation of spectral type to brightness for both giant and dwarf visual binaries; and (*c*) the low density of the reddish companions in eclipsing variable star systems. In all these cases it would be a matter of the ratio of the angle occupied by neighbouring bodies to the total solid angle.

To summarise:—As commonly interpreted, the Helmholtz-Kelvin contraction, and other but less important known stores of energy, can have maintained solar radiation for less than twenty million years. On the other hand, it is equally definite that the sun has radiated at its present rate for much more than a thousand million years; in support of strong geological evidence of a long time-scale, various astrophysical results may now be adduced, mainly from observations and interpretations of star clusters and variables. The very pronounced disagreement might be explained either if sources of energy now unrecognised could be discovered in the sun and stars, or if the necessity of modification of the physical theories could be demonstrated. "The search for an additional store of energy is not at all encouraging,"[23] since gravitational, chemical, radio-active, or other electrical sources appear unavailing. If we assume that the radiation from isolated sources, such as sidereal bodies, is not uniformly propagated in all directions,[24] we may find the solution not only to the dilemma of the ages of stars, but perhaps also to other astrophysical phenomena; and, conversely, the removal of this serious discrepancy may be proposed as an argument for a corpuscular theory of radiation, in which the direction of other bodies from a radiant source is an important factor.

HARLOW SHAPLEY.

Mount Wilson Solar Observatory, Pasadena,
California, December 14, 1918.

[19] Proc. Nat. Acad. Sci., vol. iv., p. 140 (1918); the *Messenger of Mathematics*, N.S., vol. xlvii., p. 161 (1918); *Phil. Mag.*, vol. xxxiv., p. 405 (1917). The more extended statement of the theory will appear in the Proceedings of the London Mathematical Society.

[20] Sir J. J. Thomson, Proc. Cambr. Phil. Soc., vol. xiv., p. 419 (1907). Cf. Jeans, "Report on Radiation and the Quantum-Theory" (London, 1914). pp. 81, 85 ff.

[21] The angle subtended by the large nebulæ much exceeds that of stars and planets, but it is very unlikely that the nebulæ represent a continuous distribution of matter.

[22] Mt. Wilson Communications, Nos. 19 and 34 (1916), and elsewhere.

[23] Eddington, NATURE, vol. xcix., p. 445 (1917).

[24] [December 28.] Father Rodés has pointed out to me that Poincaré, in a discussion of the impossibility of regarding the sun as a cooling body entirely without power of renewing its heat ("Hypothèses Cosmogoniques," p. 192). refers to the "solid angle" hypothesis, rejecting it, however, for the reason (which in the present problem does not now appear sufficient) that "at the moment when energy leaves the sun it obviously cannot foretell whether or not it will encounter a planet." Poincaré did not consider the discrepancy very serious between geology and the contraction theory, apparently believing that radio-activity would be competent to make up whatever defic of energy might exist.

RESEARCH AND UNIVERSITY EDUCATION.

IN his opening presidential address this session to the Royal Society of Edinburgh on "The Endowment of Scientific and Industrial Research" (Proc. Roy. Soc. Edinburgh, 1919, vol. xxxix., No. 1), Dr. John Horne discusses the report of the Committee of the Privy Council for Scientific and Industrial Research for 1917–18, and the findings of Sir J. J. Thomson's committee on the position of natural science in the educational system of Great Britain, and then turns his attention nearer home to the results of the Carnegie Trust's research scheme in furnishing trained research workers. He alludes especially to the chemistry department of St. Andrews, which has secured more research scholars and fellows under this scheme than any other educational centre in Scotland. Its favourable position in this respect is ascribed to the smallness of the number of students, to specially commodious and well-equipped laboratories, to a private research endowment which secures complete freedom of action to the head of the department and has rendered it unnecessary for him ever to approach the University Court for help, to a special field of investigation—the chemistry of sugars—capable of providing unlimited subjects for the training not only of the organic, but also of the physical and bio-chemist, and, lastly, to the initiative of the professor in finding industrial positions for the trained workers—it is to be hoped, at a salary that interests the income-tax commissioner. In the larger Scottish universities the science departments struggle under the disadvantages of inadequate laboratories, crowded class-rooms, and overworked and underpaid staffs. One hears, in fact, of nothing now but the duplication of the notoriously large medical classes, and even of the double daily lectures being given by the same lecturer. The Carnegie Trustees are asked seriously to consider whether the funds provided for scientific study and investigation cannot be increased very largely.

It is interesting to find thus officially recognised a few of the more elementary conditions for the fostering of research. The conclusion that one of the main reasons for the success of the St. Andrews chemical research school is due to the

smallness of the number of students should give at least a moment's pause to those who are urging on the movement for the expansion of the universities, and demanding that they should undertake more and more the routine instruction of the community. There is no surer way of killing research than to leave it, as it usually has been left, to take what is over in a rapidly growing democratic university, after every other need has first been canvassed. If we are, as is probable, to have greatly enlarged universities everywhere, and greatly increased Government grants for this purpose, in the name of common sense let some definite and inalienable part of these grants be put in the hands of persons who know what scientific research is.

The St. Andrews research school of chemistry is a brilliant exception just because this has been the case. A private individual, Prof. Purdie, the present professor's predecessor, founded it, built the laboratory, and provided the endowment out of his own private generosity, and left it in the hands of his successors. He knew what research was, and he has been able to effect more for research in Scotland than the million of Mr. Carnegie, in the hands of his trustees. So little did the latter understand the needs of scientific research, or how to promote it before the war, that they spent on their whole research scheme less than one-half *what they saved* out of the revenue of the fund given them primarily for this purpose. F. S.

PROF. E. C. PICKERING, For.Mem.R.S.

By the death of Prof. Edward Charles Pickering, astronomy has lost a great leader, whose stimulating influence and remarkable gifts for organisation have contributed in an extraordinary degree to the advancement of our knowledge of the stellar universe. Born at Boston in 1846, Pickering was educated at the Boston Latin School and at the Lawrence Scientific School, Harvard. At the early age of twenty-one he was appointed Thayer professor of physics at the Massachusetts Institute of Technology, where he is said to have established the first physical laboratory in the United States. In 1876 he succeeded Winlock as professor of practical astronomy and director of the Astronomical Observatory of Harvard College, and continued in this position to the time of his death, which occurred on February 3.

Pickering's work in astronomy has been especially remarkable for the numerous enterprises of great magnitude which he initiated, and for the energetic manner in which he carried his schemes to successful completion. Thanks to the generous encouragement given to scientific workers in America, the resources of the Harvard Observatory were in some measure commensurate with Pickering's great conceptions. Beginning with the erection of the 15-in. refractor in 1847, by public subscription, the resources of the observatory have since been so augmented by subscriptions, gifts, and bequests that the annual income from invested funds during recent years has provided for the employment of a staff of no fewer than forty persons. Through the Boyden bequest, in 1887, Pickering was charged with the establishment of an observatory at a high elevation, under favourable climatic conditions; and with admirable foresight as to the needs of modern astronomy, he seized the opportunity of locating the new observatory south of the equator. The station selected was at Arequipa, in Peru, at an elevation of 6080 ft., and all important researches undertaken at Harvard College have since been made to include stars in all parts of the sky, from the North to the South Pole. Another important benefaction, which largely influenced the activity of Pickering, was the Henry Draper memorial, by which Mrs. Draper made liberal provision for the continuation of the researches on the spectra and other physical properties of the stars which had been carried on by her husband, and interrupted by his death.

While precise measurements of position have not been neglected, the policy of the Harvard Observatory, from the beginning, has been the development of the physical side of astronomy, and it was doubtless very congenial to Pickering to find himself in a position to devote his energies mainly to photometry, photography, and spectroscopy. His earliest work at the observatory was the reduction of Argelander's observations of variable stars, calling for extensive photometric measurements of the brightness of the stars which had been utilised for purposes of comparison. Photometric work in general later became a leading feature of his programme of observations. For these investigations he devised the meridian photometer, with which, under favourable conditions, stars could be observed at the rate of one a minute, with an average deviation not generally exceeding one-tenth of a magnitude.

Under Pickering's guidance, and largely through his own untiring personal observations, a photometric survey of the entire heavens, involving observations to the number of more than two millions, has been made and published. The "Revised Harvard Photometry," forming vol. l. of the Annals of the observatory, and giving the magnitudes and spectra of 9110 stars, mainly of magnitude 6·50 and brighter, has thus become an indispensable source of reference in many departments of astronomical research. A later volume of the Annals (vol. liv.) extends the observations to 36,682 stars fainter than magnitude 6·50. This again has been supplemented by numerous publications on photographic photometry, including the results of investigations undertaken for the establishment of a standard scale of photographic magnitudes. These extensive researches are the chief basis of modern standard magnitudes, and have been of immense value to observers of variable stars, as well as to those occupied with stellar statistics.

The great advantages of photographic methods of observation were early realised by Pickering,

and, besides utilising photography in many of his larger undertakings, he showed great ingenuity in devising new applications for special purposes. One of his well-known devices was an instrument for automatically charting the brighter stars on every fine evening; and among numerous other arrangements was one for recording the rapid changes in brightness of short-period variables by intermittent exposures at short intervals.

The number of photographs of the heavens now accumulated in the Harvard "library of photographs" must be approaching two hundred thousand. All stars of the 11th magnitude, and many fainter ones, are shown over and over again on these plates, and the collection provides the only history that exists of the stellar universe. When any new object is discovered, as in the case of the planet Eros, or the recent Nova Aquilæ, its past history for many years has almost invariably been revealed by the Harvard plates, and a vast amount of valuable material doubtless still remains to be extracted.

In forming his plans for the spectroscopic work of the Henry Draper memorial, Pickering again took a large view of his opportunities. The photography of the spectra of stars with a slit spectroscope, one by one, though essential for the precise determination of radial velocities, is of necessity a slow process, and the objective-prism, whereby hundreds of spectra may often be obtained in a single exposure, made a strong appeal to him. The scale of the spectra yielded by this "wholesale" method is usually small, but it suffices for purposes of general classification, and thousands of stars were soon included in the spectroscopic survey. The first "Draper Catalogue," forming vol. xxvii. of the Harvard Annals, includes 10,351 stars north of $-25°$, classified on an alphabetical system, which, with some modifications, has become generally adopted by astronomers throughout the world. This work has since been continued at Harvard and at Arequipa, and a new Draper catalogue giving the spectra of nearly a quarter of a million stars is now in course of publication.

Many notable discoveries have been made in connection with the work of the Draper memorial. One of the earliest was that of the periodical duplication of the lines in the spectra of β Aurigæ and ζ Ursæ Majoris, proving these stars to be binaries, which, however, are far beyond the limits of resolving power of the largest telescopes. Mention should also be made of the discovery of the presence of bright hydrogen lines as a characteristic feature of variable stars of Secchi's third type, leading to the detection of a large number of variables of this class; and also of the interesting series of lines in the spectrum of ζ Puppis, which have since become of considerable importance in connection with theories of spectra.

Pickering was not alone a zealous worker himself; he was ever ready to aid the work of other institutions and individuals by advance copies of data which might be of use to them, by the loan of photographs, or in numberless other ways. Besides the voluminous publications of the observatory, he maintained a valuable service of bulletins and telegrams for the distribution of information respecting discoveries, made at Harvard or elsewhere, which required immediate announcement.

The value of Pickering's contributions to science was universally recognised. He was a foreign member of the Royal Society, of the Institute of France, and of most of the other important learned societies of Europe. The gold medal of the Royal Astronomical Society was awarded to him in 1886 for his photometric researches, and again in 1901 for his researches on variable stars and his work in astronomical photography. He was president of the Astronomical Society of America, and received the Bruce, Draper, and Rumford medals. Honours were also bestowed upon him by his own and other universities.

LT.-COL. W. WATSON, C.M.G., F.R.S.

BRITISH science is the poorer as the result of the war by many a distinguished name. Few have deserved more highly of their country, or done more useful work in defending our men against the scientific savagery of poison-gas shells, than Lt.-Col. William Watson as director of the Central Laboratory, B.E.F., from its establishment in June, 1915, soon after the first gas-attack, to the conclusion of 1918. The hazardous and exacting nature of this work, in the course of which Watson was frequently "gassed," no doubt largely contributed to his death, which took place, after two months in hospital, on March 3, at the comparatively early age of fifty. The full record of the manifold activities of the Central Laboratory under his direction will doubtless appear in its appropriate place when further details are available. We must be content here with a summary of his career as a scientific investigator.

Watson received his training, in the accurate and delicate physical manipulation which distinguished all his work, at the Royal College of Science under Sir Arthur Rücker and Prof. Boys, and took his B.Sc. degree in 1890, securing first place on the list of honours in physics. He obtained an immediate appointment as demonstrator in the college, and afterwards succeeded to the assistant professorship in 1897. He was elected a fellow of the Royal Society in 1901, and became in due course one of the professors of physics at the Imperial College of Science and Technology.

Watson's first scientific work was as assistant in the great magnetic survey of the British Isles instituted by Rücker and Thorpe, 1890–95, in which he did the lion's share of the observational work, and appears in the record as the most accurate of the observers. He also had the advantage of assisting Prof. Boys in his delicate experiments with the radio-micrometer, in timing the periodicity of the electric discharge, and in photographing the flight of bullets. In the meantime he was occu-

pied, in conjunction with the late J. W. Rodger, on an elaborate investigation of the magnetic rotation of the plane of polarisation in liquids (Phil. Trans., 1895, pp. 621–54), which has not yet been surpassed. A research of a similar character by an original method, on the determination of the earth's magnetic field (Phil. Trans., 1902, pp. 431–62), threw great light on some of the sources of error in absolute magnetic measurements.

While engaged in these researches, and taking his full share of the teaching work, Watson yet found time to write his well-known "Text-book of Physics," which has become deservedly popular, and has made his name familiar to an ever-increasing circle of students. As a teacher his clearness of exposition and his skill in devising experimental illustrations made his lectures very attractive to the serious student.

A large part was taken by Watson in the design and equipment of the new laboratory (now part of the Imperial College) to which the physics department of the Royal College was transferred in 1905. He next became interested in the application of physical methods to the scientific study of the petrol motor, and devised many ingenious instruments of research, including a new type of optical indicator, which has proved invaluable for accurate work on high-speed engines. The laboratory which he designed and equipped for these experiments has since been taken over and extended by the Air Ministry, and proved very useful during the war for the solution of urgent problems in connection with aero-engines. Many of his results were of fundamental importance, and will be found in most standard treatises on the subject.

Watson assisted Sir W. de W. Abney for many years in his researches on colour vision, and made useful contributions of his own to the theory and methods of measurement, a characteristic example of which will be found in his paper on luminosity curves (Proc. R.S., 88 A, p. 404, 1913). In a later paper Sir W. Abney indicates that they were busily engaged on work of great promise in this direction when Watson was "commandeered as scientific adviser at the front." The work which he accomplished in this capacity was doubtless of the greatest national importance, but, in the interests of pure science, one cannot help regretting that so active and many-sided an investigator should have been cut off in his prime by the relentless exigencies of war.

NOTES.

After two years' interval, owing to war conditions, the British Association for the Advancement of Science will resume its series of annual meetings this year at Bournemouth from September 9 to 13, under the presidency of the Hon. Sir Charles Parsons.

Sir George Newman, K.C.B., Chief Medical Officer, Local Government Board, has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

At the quarterly Court of the governors of the London Hospital, held on March 5, Lord Knutsford made the important announcement that it is proposed to fill up two vacancies on the honorary visiting staff by the appointment of two whole-time adequately paid officers in charge of the beds. Under the new arrangement there would be a director, three clinical assistants, and laboratory and clerical assistants. These members of the staff will give their whole time to curing disease, to researches on the causation of disease, and to the education of the medical students, and they will be of precisely equal rank with the other members of the honorary staff. It will be remembered that this kind of arrangement was suggested in the report of the Haldane University Commission, and has been commended by Sir George Newman in his "Notes on Medical Education."

The ravages of the larvæ of ox warble-flies are well known to farmers, butchers, hide-dealers, and tanners. The flesh of bullocks and the milk yield of cows suffer through the presence of these parasites, and the piercing of the hides greatly reduces the value of the latter. Furthermore, the annoyance caused by the flies during a hot July or August prevents cattle from thriving so well as they otherwise would do. So far little or no good results have been achieved from the application of various dips and smears which are intended to prevent oviposition by the flies. The only measure that can be advocated with any confidence is the systematic destruction of the larvæ in the backs of the cattle. This method has the obvious disadvantage that the parasite is destroyed only after it has wrought its injuries. Impressed by the damage caused by the fly, the War Office called a conference last July of Government Departments, men of science, traders, and others familiar with the pest to discuss measures for its extermination. A scientific sub-committee, presided over by Sir Stewart Stockman, will supervise experimental researches. A Government grant has been sanctioned, and the experiments are designed to furnish information on methods of preventing egg-laying of the fly, and on the effects of drugs in destroying the larvæ in the body of the host before they commence to penetrate the hide.

The predominant character of the weather over the British Isles since the commencement of the year has been rainy and dull. The rainfall in January exceeded the average over the whole kingdom except in Scotland N., where there was a deficiency of about 2 in. At Bournemouth the rainfall was 252 per cent. of the normal, at Arundel 236 per cent., and in London, at Camden Square, 176 per cent. At Kew Observatory the excess of rain was 1·77 in., at Southampton 2·24 in., and at Falmouth 2·86 in. February rainfall was in excess of the average in the south and east of England, and deficient elsewhere. At Greenwich the excess of rain was 0·75 in., at Cambridge 1·85 in., at Southampton 2·32 in., and at Falmouth 2·80 in. In the first ten days of March rains were generally heavy; at Greenwich, in the three days ending March 5, the rainfall measured 1·49 in., which is 0·03 in. more than the sixty years' average for the whole month. The aggregate duration of bright sunshine since the commencement of the year has been deficient in all districts of the British Isles except in Ireland and in Scotland N.; in the south-east district of England the deficiency amounts to 0·6h. daily for the first nine weeks, or

in all 38h. At Kew Observatory the sunshine in February was little more than one-half of the average, and at Cambridge it was less than one-half of the normal.

DR. S. F. HARMER, keeper of the Department of Zoology, Natural History Museum, has sent us a letter in which he points out that the remarks upon the directorship of the museum published in our issue of March 6 may be read as an undeserved reflection upon the value of the scientific services rendered to the museum by the assistant secretary, Mr. C. E. Fagan. For ourselves, we gladly accept Dr. Harmer's testimony of high appreciation of Mr. Fagan's services to science during the long period he has held office. We are, however, concerned solely with the principle, common in Government Departments, of appointing lay officials to direct scientific institutions. It is of the utmost importance at the present time not to concede this principle even when personal considerations may all be in favour of the appointment proposed. Dr. Harmer says that Mr. Fagan's work "has been essentially scientific, and that his services in rendering the national museum a scientific institution have been exceptionally great." These are, of course, claims to consideration, and no doubt the Trustees will give full attention to them. Our point is that, whatever candidates are forthcoming, scientific knowledge and experience should determine the appointment, and not purely administrative ability.

THE Department of Scientific and Industrial Research has just issued two revised Circulars, Research Association 1 and 3, the first giving an outline of the Government scheme for industrial research, the second the conditions as to the payment to research associations by the committee of council. As will be remembered, the Government has placed a fund of a million sterling at the disposal of the Research Department to enable it to encourage the industries to undertake research. This new fund is being expended on a co-operative basis in the form of liberal contributions by the Department towards the income raised by voluntary associations of manufacturers established for the purpose of research, and the joint fund for each industry is under the sole control of the councils or boards of the respective research associations so formed, subject to the conditions outlined in the second Circular referred to above. The results obtained from research will be available for the benefit of the contributing firms, but no firms outside the organisation will have any such rights. The associations are to be companies limited by guarantee of a nominal sum and working without profit, *i.e.* without division of profits among the members in the form of dividends. Moreover, the subscriptions of the contributing firms will not be subject to income or excess profits taxes, and the income of the association will similarly be free from income tax. The Government grant will be given for a period of years to be agreed upon, not exceeding five, except in special cases. The general practice, we believe, is to grant pound for pound raised by subscriptions within certain minimum and maximum limits, specified in each case, for the stipulated period, although, where the special circumstances of the industry may need it, this ratio may be increased. There is, moreover, provision for a possible increase of the grant where the association raises additional sums, and for reduction where it fails to reach the specified minimum.

THE *Times* of March 1, 3, and 4 contained long articles dealing with the necessity for the unification of the administration and the further development of the fishing industry. Two rather different points of view were taken by the writers; a special correspondent stated what may be regarded as the expressed opinions of the fishing industries—that is, the great trawling companies, the wholesale and retail traders, and the conservation industries; while Lord Dunraven stated the views of the Sub-Committee on Fisheries of the Empire Resources Development Committee. On one hand, the trade interests press for a great simplification in the existing machinery of central and local regulation and administration, consolidation of the law with regard to fishing, and the formation of a strong and adequate Imperial Ministry with the development of the industry as its single task. This would be directed to securing the means of speedy and economical transport and distribution of the fish landed, processes which are at present inadequate and wasteful. It would be closely and integrally linked up with—would actually include—the means of scientific, statistical, and industrial research carried out in the closest possible association with the industry itself and the machinery of administration. It would see that the present neglect of the inshore fisheries—shell-fish in particular—should cease, and it would greatly develop the fresh-water fisheries, particularly those for salmon and eels. On the other hand, Lord Dunraven emphasises the points of view of the State and the consumer rather than those of the trades voiced by the National Sea Fisheries Protection Association, namely, State control, co-operative enterprise, and development of the fisheries of the Dominions. To the trade, fish that is scarce and dear is easier to handle than, and at least as profitable as, fish that is cheap and plentiful. From the point of view of the consumer and of the State, cheap food, a large and prosperous fishing population, and, if possible, some revenue, ought to be the objects of reconstruction of the industries concerned.

NEXT Tuesday, March 18, Prof. A. Keith will deliver the first of a course of four lectures at the Royal Institution on British Ethnology: The People of Scotland. On Thursday, March 20, Prof. C. H. Lees will give the first of two lectures on Fire Cracks and the Forces Producing Them. The Friday discourse on March 21 will be delivered by Prof. W. W. Watts on Fossil Landscapes; and on March 28 by the Right Hon. Sir J. H. A. Macdonald on The Air Road.

THE death is announced of Major H. G. Gibson, who fell a victim to influenza probably contracted in the course of investigations on this disease. Major Gibson, with Major Bowman and Capt. Connor, published a paper in the *British Medical Journal* for December 18, 1918, in which they brought forward evidence that the influenza virus is of a "filterable" nature, *i.e.* is so minute that it will pass through a fine porcelain filter. Sputum from influenza cases was diluted and filtered through a Pasteur-Chamberland filter, and the filtrate was then inoculated subconjunctivally and intranasally into monkeys. The animals suffered from a condition resembling influenza, and the post-mortem condition found was in many respects comparable with that obtaining in human cases.

AN article by Dr. C. Davison in the *Observer* for March 9 deals with Prof. de Quervain's suggestion that a portion of the high explosives left in this country should be used for experimental explosions (NATURE, vol. cii., p. 371). After describing the principal results that might be expected from such experiments, the author points out that the firing of large amounts of explosive (Prof. de Quervain suggests fifty tons) is unnecessary. The sound from the explosion of 24½ tons of dynamite on the Jungfrau railway in 1908 was heard for 112 miles, and that of

the explosion of 197 tons of gunpowder at Wiener Neustadt in 1912 for 186 miles. On the other hand, the reports of the minute-guns at Spithead in 1901 were heard to a distance of 139 miles, and in this case seven-pound charges were fired from at the most thirty men-of-war, or a total of less than two hundredweight, even supposing that the guns were fired simultaneously.

INFLUENZA has again made a steady increase in its virulence over the British Isles, and the Registrar-General's return for the week ending March 1 shows that in London (county) the deaths from the epidemic were 808, and in the ninety-six great towns, including London, they were 3889, both of which are the highest numbers since the closing week of November. The deaths from influenza in London had risen to 32 per cent. of the deaths from all causes, whilst in the preceding week they were only 25 per cent., but pneumonia had decreased from 14 per cent. to 12 per cent., and bronchitis from 16 per cent. to 13 per cent. In London there was some improvement in the general health, the total deaths from all causes having decreased from 2643 in the preceding week to 2501, and the annual death-rate per 1000 of the aggregate population had decreased from 34·2 to 32·4. In London 47 per cent. of the deaths from influenza during the week ending March 1 occurred at the ages from twenty to forty-five. In the twenty-one weeks since the commencement of the epidemic in October of last year influenza has caused 32 per cent. of the deaths from all causes, pneumonia 12 per cent., and bronchitis 9 per cent.

SIR ARTHUR EVANS in the *Times* of March 4 acts as spokesman of an influential committee formed under the auspices of the British Academy, and representing various learned societies interested in archæological research, which has presented a memorial to the Lords of the Treasury strongly urging the creation of an Imperial British Institute of Archæology in Cairo, with the aid of a State subsidy. Sir Arthur Evans justly points out that the position occupied by British archæologists in Egypt is markedly inferior as compared with the French and Germans, who already possess institutes of this kind, and with the Americans, who have large resources at their disposal. It is true that the Egyptian Exploration Fund and the British School of Archæology in Egypt, in spite of a very limited income, have done admirable work. But they are hampered by lack of funds to provide a home for their workers, instruction for their students, and an adequate library. Experts working under this system receive neither suitable remuneration nor any guarantee that they will be able to follow up their archæological career. Hence, while many of our university students are ready to assist in the work, they have little encouragement to make archæology their profession. It is also probable that the classes which contributed to these enterprises before the war will be unable to maintain their subscriptions.

A SPECIAL clinical and scientific meeting of the British Medical Association will be held in London on April 8–11. A popular lecture, on the surgery of the war, will be given by Major-Gen. Cuthbert Wallace. An exhibition of surgical instruments, hospital furniture, drugs, foods, sanitary appliances, etc., will be held at the Imperial College of Science and Technology, South Kensington, from Wednesday, April 9, to Friday, April 11, both days inclusive. On the evening of April 9 the Royal Society of Medicine will hold a reception at its house, 1 Wimpole Street, W. The guests will be received by Sir H. D. Rolleston, president of the society. The following discussions have been arranged; the names given are those of the introducers:—*Section of Medicine:* "War Neuroses," Lt.-Col. F. W. Mott; "Influenza" (in conjunction with the Section of Preventive Medicine and Pathology), Major-Gen. Sir W. Herringham, Capt. M. Greenwood, and Major Bowman; "Venereal Disease," Brevet-Col. L. W. Harrison; and "Prognosis in Cardio-vascular Affections," Dr. T. Lewis. *Section of Surgery:* "Gunshot Wounds of the Chest," Col. T. R. Elliott and Col. G. E. Gask; "Wound Shock," Prof. W. M. Bayliss and Dr. H. H. Dale; and "A Review of Reconstructive Surgery," Major R. C. Elmslie and Major W. R. Bristow. *Section of Preventive Medicine and Pathology:* "The Dysenteries: Bacillary and Amœbic," Col. L. S. Dudgeon and Prof. W. Yorke; "Influenza" (at a joint meeting with the Section of Medicine); and "Malaria," Lt.-Col. S. P. James.

THE introduction of the aniline dye industry has, as is well known, ruined the art of vegetable dyeing; and though we possess ancient fabrics dyed with vegetable colours, it is often not possible to trace the plants which yielded them. The aborigines of America were well versed in the art, and many Peruvian textiles are remarkable for their beautiful and permanent colours. Mr. W. E. Safford, in the Journal of the Washington Academy of Sciences (vol. viii., No. 19), gives an interesting account with figures of the xochipalli, or flower-paint of the Aztecs, which has hitherto been unidentified. The plant was described and figured three centuries ago, and has been supposed to be a species of Tagetes, but Mr. Safford has proved that the plant is really *Cosmos sulphureus*, and has verified his discovery by obtaining the rich orange-red from a decoction of the flowers, which is the colour of xochipalli described by Hernandez. Several of the other beautiful pigments derived from vegetables, used by the ancient Mexicans for the picture-writing of their celebrated codices, are referred to in this paper, and the names of the plants are given.

IN the February issue of *Man* Dr. W. Crooke discusses the question of hut-burning in India. In recent years several notices have been published of a custom prevailing from the Punjab southward to the Central Provinces of barren women burning pieces of thatch taken from the roofs of seven huts in the hope of obtaining offspring—a custom which in some places has led to fires and loss of life. The practice was explained by the late Mr. R. V. Russell on the theory that the woman burns the thatch in the hope that the spirit of one of the children of the family may be reincarnated in her body. It is true that dead children are often buried under the threshold in the belief that their spirits may be reborn in one of the women of the family, but, as Dr. Crooke observes, the intentional destruction of animal life is repugnant to many Hindus, and examples of reincarnation, as suggested in the present case, do not seem to be forthcoming. Dr. Crooke suggests another explanation. A barren woman is naturally regarded as being under taboo, sterility being universally attributed to the agency of malignant spirits. He quotes many instances to show that it is the custom that when a man or woman is accused of adultery or other offences against the laws of caste, the offender is purified by passing through seven straw booths which are successively set on fire. This leads to the conclusion that, in the case of barren women, the rite is a form of purgation which relieves her of the impurity to which sterility is attributed.

PROF. D'ARCY THOMPSON, in the January–February issue of the *Scottish Naturalist*, continues his most

interesting notes on whales landed at the Scottish whaling stations, dealing in the present instalment with the bottle-nose, humpback, and finner whales. During the six years covering the period of these observations only twenty of the first-named species were landed at the Scottish stations, and this, not because of its rarity, but because it does not pay commercially to take these animals in small numbers, when they have to be towed ashore to be "tried out." Of the specimens landed none were fully adult. Of the humpback whales only thirty-one specimens were landed in Scotland during this period. Twenty-three were males, the largest of which measured 51 ft. in length. July was the chief month of capture. The finner, or common rorqual, is by far the commonest species taken at these stations, as is shown by the fact that during the period under review no fewer than 2409 were killed. The largest of the females, which slightly exceed the males, measured 81 ft. in length. Finally, in regard to all the species, Prof. Thompson gives some valuable figures as to the relation of the girth to the length, and much very acceptable information as to migration.

MR. C. RAUNKIAER (*Kgl. Danske Videnskab. Selskab. Biol. Meddel.*, i., 3, 1918) contributes a paper (in French) of considerable detail entitled "Statistical Investigations on Plant Formations," dealing more especially with those of northern Europe. A general description is given of the frequency and distribution of the species entering into the formations, of the relative proportions of the species, and of the common biologic characteristics by which the species of a formation adapt themselves to their habitat. The chief points to be noted for a complete ecological description of any given area are summarised, and a scheme is drawn up for a scientific description of plant formations.

THE Department of Agriculture of the Union of South Africa has issued a useful little pamphlet (Bulletin No. 5, 1918) entitled "Agricultural Grasses and their Culture," by Mr. H. A. Melle. In the early days, when the open veld afforded large areas of excellent pasture, little, if any, attention was given to the improvement of pastures. But the smaller farms consequent on a denser population of the country has necessitated experiments with exotic grasses for the improvement of pastures. The pamphlet gives an account of the grasses and some of the forage plants grown at the Botanical Experiment Station, Pretoria, and the writer discusses the merits and characteristics of the different species, so that farmers may judge for themselves which particular grass will be best suited for their purpose and locality.

VOL. VI. of "Fossil Vertebrates in the American Museum of Natural History" has just been received from the Department of Vertebrate Palæontology of that institution. It includes contributions 168 to 192, which appeared during the years 1915 to 1917 inclusive, from the studies of Osborn, Matthew, Brown, Granger, Gregory, Mook, Anthony, Watson, and von Huene. These articles are collected from the Museum Bulletin volumes of the corresponding years. The edition is limited to sixty copies, and is distributed to the principal research centres in various countries.

MR. R. H. PARSONS contributes a valuable paper on the coal consumption of steam-power plant to the *Electrical Review* of February 21. He points out that if the consumption of coal in a power station be plotted against the horse-power developed, all the points lie practically on a straight line. If W be the number of pounds of coal consumed and P the brake-horse-power developed, then, in symbols, $W=a+bP$, where a and b are constants which depend on the plant in the station. Similarly, if W' be the number of pounds of steam consumed, we have $W'=c+dP$, where c and d are constants. These laws are practically identical with the laws which Willans proved in connection with high-speed engines. We deduce, for instance, that the steam consumed per brake-horse-power developed will be W'/P, *i.e.* $d+c/P$. It is suggested that the mean lines should be found which give the graphs of W, P and W′, P for the central station. If all the actual points shown on the curve lie very near this line, then the station is being worked economically. Whenever the points lie considerably above the mean line there is need for inquiry, and the fault will be found either in the boiler- or in the engine-room.

AN article on the economic size of concrete ships appears in *Engineering* for February 14. The author —Mr. E. O. Williams—plots a series of curves, and deduces from them the following information:—After 1500 tons dead-weight the displacement increases more rapidly than the increase in dead-weight. Minimum indicated horse-power per ton dead-weight occurs at 8000 tons dead-weight. Minimum cost of hull occurs at 4000 tons dead-weight. From these points it appears that the economic limit to concrete ships is between 5000 and 8000 tons dead-weight. At 1500 tons dead-weight the concrete ship is most favourably compared with a steel ship for displacement and indicated horse-power. The saving in steel at 1500 tons dead-weight is 74 per cent., and at 8000 tons dead-weight 38 per cent. Vessels above 8000 tons dead-weight are not economic in concrete; there is no saving in steel at 12,000 tons dead-weight; the displacement and the cost of the hull per ton dead-weight increase rapidly above 8000 tons. Concrete ships are most economical between dead-weights of 1500 and 4000 tons, and the best size is in the neighbourhood of 3500 tons dead-weight.

THE leading article in *Engineering* for February 21 deals with concrete roads, and considers the requisites of a good road with the view of discussing how far concrete fulfils the requirements. There is no question regarding the hardness of well-made concrete, but the length of life depends upon various other considerations. The road should offer low resistance to the movement of traffic over it. Recently some experiments were made in California with the view of ascertaining the pull necessary on different road surfaces to keep three tons of load in motion after it had been started. With water-bound macadam in good condition the pull was 64 lb. per ton; on a bituminous road, 49 lb.; on unsurfaced concrete, 28 lb. In other words, the load which would be kept in motion by four horses on unsurfaced concrete would require seven horses on an asphaltic surface and nine on a water-bound macadam. Concrete roads do not disintegrate under the traffic, and do not soften with rain or snow; there is, therefore, neither dust nor mud. Cleansing the surface can be carried out easily and rapidly without damaging the surface in any way whatever. The surface of a properly made concrete road does not work into waves, nor does it disintegrate or develop holes. The ideal road must not be slippery, and modern concrete roads possess surfaces which afford a good grip for hoof or tyre. Owing to the readiness with which water runs off the surface a much smaller camber may be employed, and there is thus less temptation for drivers to use the middle of the road only. Concrete roads are not affected by climatic conditions. The initial cost is higher, but the maintenance cost is much lower, than both water-bound and bituminous macadam.

The maintenance cost of the experimental stretch of concrete on the London to Chatham road, laid in 1915, has been *nil* during the four years.

A NEW series entitled "Manuals of the Science of Industry" is announced by *Messrs. Longmans and Co.* It will be edited by E. T. Elbourne, and the first volumes will be "Labour Administration," the Editor; "Law and Industry," A. S. Comyns Carr; and "Health and Industry," W. H. Judson. These are in active preparation. The *Open Court Co.* will publish shortly "Lectures on the Philosophy of Mathematics," J. B. Shaw. The *Wireless Press, Ltd.*, has in the press "The Year-Book of Wireless Telegraphy and Telephony, 1919"; "Continuous-wave Wireless Telegraphy," Dr. W. H. Eccles, part i.; "Telephony without Wires," P. R. Coursey; "Alternating-current Working," A. Shore; "Principes Elémentaires de Télégraphie sans Fil," R. D. Bangay; and "Manual de Instruccion Tecnica para operadores de Telegrafia sin Hilos," J. C. Hawkhead and H. M. Dowsett.

THE latest catalogue (No. 177) of Messrs. W. Heffer and Sons, Ltd., Cambridge, mainly deals with books treating of subjects outside the range of a journal such as NATURE, but one section gives particulars of some recent purchases of works relating to scientific subjects. Among them we notice vols. i. to xiii. of the *New Phytologist*; Moore's "Lepidoptera Indica," 10 vols.; Moore's "The Lepidoptera of Ceylon (Rhopalocera and Heterocera)"; "Catalogue of the Birds in the British Museum," "Catalogue of Birds' Eggs," "Hand-List of Birds," "General Index," in all 38 vols.; Sowerby's "English Botany, or Coloured Figures of British Plants, with their essential Characters, Synonyms, and Places of Growth," and the index, with the Supplements, and MS. index; Parkinson's "Theatrum Botanicum: The Theatre of Plants, or an Herbal of a Large Extent," first edition; and Roscoe's "Monandrian Plants of the Order Scitamineæ."

THE special catalogues of Messrs. J. Wheldon and Co., 38 Great Queen Street, Kingsway, W.C.2, are always worthy of note, being very carefully classified and containing books not easily procurable. The one just issued (new series, No. 86) is no exception to the rule, and should be seen by all entomological readers of NATURE. It contains particulars of more than 1100 volumes dealing with entomology in its various branches, conveniently arranged under the headings Lepidoptera, Coleoptera, Arachnida, Myriapoda, Diptera, Hemiptera, Hymenoptera, Neuroptera, Orthoptera, General Entomology, and Economic Entomology. In addition, attention is directed to sets and long runs of many scientific serials. The catalogue is sent post free on receipt of 2*d*.

OUR ASTRONOMICAL COLUMN.

THE REFORM OF THE CALENDAR.—It will be remembered that this subject was much to the fore before the war, and it is now again attracting attention. The *Comptes rendus* of the Paris Academy of Sciences for January 6 and 20 contain papers upon the subject by M. G. Bigourdan and M. H. Deslandres respectively. Both agree that each quarter should consist of two months of thirty days each, followed by one of thirty-one. This makes each quarter just thirteen weeks. There would be a supplementary day at the middle of the year; in leap-year an additional one at the end. M. Deslandres (but not M. Bigourdan) is in favour of putting these days outside the weekly reckoning, so that every year would have the same days of the week on the same days of the month. There is no question that the existing calendar, with its irregular months, short February, and leap-day at the end of the second month, is very ill-contrived; it is only the difficulty of agreement as to the best alternative that has permitted it to survive so long.

DARK MARKINGS ON THE SKY.—Prof. Barnard has often described these dark patches of definite outline, which strongly suggest, by their appearance and by the abrupt alteration in star-density, that they are due to clouds of obstructing matter. He gives a catalogue of 182 of these objects in the *Astrophysical Journal* for January. They are mainly, but not wholly, in the Galaxy. He suggests that in many regions of the sky there is enough background luminosity, due either to unseen stars or diffused nebulous matter, to throw them into relief; one such is in R.A. 4h. 22m. 50s., N. decl. $46° 21'$; it is a dark, elliptical space $15' \times 10'$. It is curious that Prof. Barnard's paper is in juxtaposition with one by Dr. Harlow Shapley on the distances of the globular clusters; taken in conjunction with recent evidence of the wide distribution of calcium in cosmic clouds, it tends to weaken our confidence in the perfect transparency of space which is one of the postulates of Dr. Shapley's deductions. Prof. Barnard gives photographic reproductions of nine of the dark regions in the galactic clouds. In some cases they are fairly round and regular, in others they present complicated and contorted forms.

THE ASTROGRAPHIC CATALOGUE.—Vol. ii. of the Hyderabad section of this Catalogue has just been published, containing the measures of the stars on the plates the centres of which lie in decl. $-18°$. There are 61,378 stars in the volume, which is at the rate of $3\frac{1}{2}$ millions to the whole sky. Their x, y co-ordinates are given, and the measured diameters. A separate formula is calculated for each plate, of the form $A-B\sqrt{d}$, to reduce to the ordinary magnitude scale. The limiting magnitude for most of the plates appears to be about 13. Standard co-ordinates are also given for all the stars that occur in the Algiers or Washington Astr. Gesellschaft catalogues, which are for the same epoch (1900) as the present catalogue. There are also auxiliary tables for forming the R.A. and declination of any star, if required.

This volume has a pathetic interest in that the director, Mr. R. J. Pocock, has died since it was sent to press. In spite of war difficulties, he accomplished a great deal of work during his few years at Hyderabad. Much of it is still unpublished.

A SUGGESTED GOVERNMENT CHEMICAL SERVICE.

AN important memorandum has been drawn up by the council of the Institute of Chemistry, which desires to direct the attention of the Government to the increasing and vital importance of chemical science in affairs of the State. The memorandum is published in the Proceedings of the institute, part iv., recently issued.

The council is of opinion that the time is opportune for taking steps to secure for the profession of chemistry a position corresponding with that occupied by other learned professions. It considers that much would be accomplished towards the attainment of that aim if, in the first place, adequate and uniform conditions of appointment were accorded to chemists directly engaged in the service of the State. These include chemists occupied in research, in analysis, and in technological work, as well as those employed in

educational work. It is chiefly to the first three branches that the memorandum relates.

Only persons possessing recognised qualifications should be eligible for appointment as chemists in the Government chemical service. Such appointments should be rendered attractive to those who have reached the required standard of efficiency, and there should be no confusion between these chemists and their unqualified assistants.

The council regards it as a first principle that steps should be taken to remove the confusion (existing in this, but in no other country) which arises from the use of the title "chemist" by those who practise pharmacy.

It is suggested that the appointment of chemists should be based on a system of selection by properly constituted authority, and not by examination or nomination. Further, the persons appointed as chemists should be graded as Civil Servants in the higher division, preferably as members of a professional division, with status, emoluments, and pension comparable with those of the members of other technical and learned professions employed by the Government.

A further suggestion is that, subject to satisfactory service being given, the system should provide for certainty of promotion, independently of the occurrence of vacancies, up to a definite rank, not necessarily the highest, but one securing an adequate salary to a married man. This is regarded as essential if men of the best type are to be obtained. A chemist should be constantly increasing in efficiency, and this should be recognised by the provision mentioned.

Suitable titles for the service, it is considered, would be Chief Chemist (with a special departmental title in certain cases), followed by Deputy Chief Chemist, Superintending Chemist, and Assistant Chemists (Principal, Senior, and Junior). The rank held by the head chemist would be determined by the size of the establishment and the nature of the work carried out. The secondary staff, to whom the title of chemist would not apply, should be classified into Chemical Assistants, Laboratory Assistants, and Laboratory Attendants. The first of these three classes would include men of good education, but without full professional qualification; on obtaining this they would be eligible for appointment as chemists.

The council of the institute believes that direct advantage would accrue to the State from such an organisation, and that the status of the profession of chemistry would be raised. This would, incidentally, contribute to the advancement of chemical science.

ROGER BACON (1214–94).

IN a paper entitled "Notes on the Early History of the Mariner's Compass" in the *Geographical Journal* for November, 1918, Mr. M. Esposito ably shows the difficulty of stopping a fable when it has once gone forth, and, incidentally, reveals the small amount of knowledge possessed even by eminent men of science of the actual facts of the life of the first modern man of science. Mr. Esposito clearly demonstrates to the scientific public what was already known to Baconian scholars: that Roger Bacon, great as are his titles to remembrance, was neither the inventor nor introducer of the mariner's compass.

At a time when the claims of Englishmen to a leading place in the history of science are being pressed with so much vigour, it is disheartening to find that the great founder of modern scientific thought, though himself an Englishman, is usually forgotten or his work misunderstood. Oxford, his *alma mater*, with her thoughts and gaze turned to the remoter past, has scarcely glanced at Bacon, and, save for the faithful labours of Prof. Little, Dr. Withington, and the late J. H. Bridges, has only thought fit to regard one of the greatest of her sons as a buffoon for her pageant. Italy has her national edition of Galileo; France has produced, at the expense of her Government, two monumental editions of the works of her national philosopher, Descartes; and even little Denmark has found a private patron to provide the magnificent definitive edition of Tycho Brahé. Yet the writings of Bacon remain neglected, many of them unprinted, most of them in old or inaccurate editions. Even more astonishing is the fact that not a single important work of Bacon has appeared in English. Were it not for the public spirit of Mr. R. R. Steele, who for years has been labouring at the text, and whose fascicules have been issued from the Clarendon Press, Bacon, the herald of the new dawn, would have been almost forgotten in his own university.

The ideas in circulation as to the achievements of Roger Bacon are usually so vague that it may be convenient to place on record, in categorical form, his claims as a scientific pioneer:—

(1) He attempted to set forth a system of natural knowledge far in advance of his time. The basis of that system was observation and experiment. He was clearly the first man in modern Europe of whom this can be said.

(2) He was the first man in modern Europe to see the need for the accurate study of foreign and ancient languages. He attempted grammars of Greek and Hebrew along definite scientific lines. He also projected a grammar of Arabic. Moreover, he laid down those lines of textual criticism which have only been developed within the last century.

(3) He not only expatiated on the experimental method, but was himself an experimenter. The criteria of priority were not then what they are now, but his writings are important in the development of the following sciences:—

(*a*) *Optics*.—His work on this subject was a textbook for the next two centuries. He saw the importance of lenses and concave mirrors, and showed a remarkable grasp of mathematical optics. He described a system which is equivalent to a two-lens apparatus, and there is trustworthy evidence that he actually used a compound system of lenses equivalent to a telescope.

(*b*) *Astronomy* was Bacon's perpetual interest. He spent the best part of twenty years in the construction of astronomical tables. His letter to the Pope in favour of the correction of the calendar, though unsuccessful in his own days, was borrowed and reborrowed, and finally, at third-hand, produced the Gregorian correction.

(*c*) *Geography*.—He was the first geographer of the Middle Ages. He gave a systematic description, not only of Europe, but also of Asia and part of Africa, and collected first-hand evidence from travellers in all these continents. His arguments as to the size and sphericity of the earth were among those that induced Columbus to set out on his voyage of discovery.

(*d*) *Mechanical Science*.—Suggestions described by him include the automatic propulsion of vehicles and vessels. He records also the working out of a plan for a flying-machine.

(*e*) *Chemistry*.—The chemical knowledge of his time was systematised in his tracts. His description of the composition and manufacture of gunpowder is the earliest that has come down to us. It is clear that he had worked out for himself some of the chemistry of the subject.

(*f*) *Mathematics*.—His insistence on the supreme value of mathematics as a foundation for education

recalls the attitude of Plato. It was an insistence that the method of thought was more important than its content.

Summed up, his legacy to thought may be regarded as accuracy of method, criticism of authority, and reliance on experiment—the pillars of modern science. The memory of such a man is surely worthy of national recognition. CHARLES SINGER.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE seventy-first meeting of the American Association for the Advancement of Science was held at the Johns Hopkins University, Baltimore, Md., on December 23–28, 1918, under the presidency of Dr. John Merle Coulter, of the University of Chicago.

The arrangements for the meeting were made before the close of the war, and the armistice in November was, naturally, not anticipated. It had been intended originally to hold this meeting in Boston, but the place was changed on account of the fact that Baltimore (in close proximity to Washington) was most convenient for the small army of scientific workers who were engaged at the national capital. In the interval between November 11 and the Christmas holidays, however, the character of the programme was largely altered, and reconstruction papers were substituted in many cases for war papers, and some of the symposia were altered accordingly. The total attendance approximated eight hundred, and the following affiliated societies met with the association:—Americal Physical Society, Optical Society of America, Association of American Geographers, Geological Society of America, American Society of Naturalists, American Society of Economic Entomologists, Ecological Society of America, Botanical Society of America, American Phytopathological Society, American Anthropological Association, Psychological Association, American Metric Association, Society of American Bacteriologists, American Society of Horticultural Science, Society of American Foresters, School Garden Association of America, and American Association of the University Professors.

The outstanding character of the meeting is indicated by the titles of some of the addresses and symposia, a few of which may be mentioned. The address of Dr. H. J. Waters, of Section M, is entitled "The Farmers' Gain from the War," and this was followed by a symposium on "The Agricultural Situation in Europe and Measures for Reconstruction." Members of the American Agricultural Mission, recently returned from Europe, took part in this symposium. The address by Dr. H. S. Drinker, before Section D, was on "The Need of Conservation of our Vital and Natural Resources as Emphasised by the Lessons of the War."

The American Foresters' Association held a symposium on "Forest Reconstruction." Section L held one on "The Education of the Disabled Soldier." The Optical Society of America presented a symposium on applied optics, and the address of the president, Dr. F. E. Wright, was on the optical industry in war-time. Before the Association of American Geographers Prof. G. A. Condra read a paper entitled "Potash a Factor in Winning the War," and Prof. R. DeC. Ward on "Weather Controls over the Fighting during the Autumn of 1918."

Section F, in a joint meeting of the American Society of Naturalists, held an important symposium on the subject of "The Need of Securing Better Cooperation between Government and University Laboratory Zoologists in the Solution of Problems of National Importance." This symposium is the direct outcome of the war, the university men having become convinced that they can help the Government more than they have in the past.

Dr. R. A. Harper, of Section G, discussed "The Stimulation of Botanical Research after the War," and Dr. G. T. Moore "Botanical Participation in War-work." The programme of the American Phytopathological Society contained several discussions of war emergency projects in regard to crop diseases.

The programme of Section H and of the American Anthropological Association dealt almost entirely with questions relating to the war. Some of the titles may be mentioned:—"A Unified Blank of Measurement to be Used in Recruiting in Allied Countries: A Plea for the Unification of Anthropological Methods," by Prof. Fabio Frasetto, of the Royal Italian Embassy, and also of the University of Bologna; "The War Museum and its Place in the National Museum Group," by Dr. W. H. Holmes; "Race Origin and History as Factors in World-Politics," by Dr. J. C. Merriam; "The Effect of the War upon the American Child," by Ruth McIntire, of the National Child Labour Committee; "The War and the Race," by Dr. A. Hrdlička, U.S. National Museum; and "Examinations of Emotional Fitness for Warfare," by Dr. R. W. Woodworth, of Columbia University. There were also several papers before Section H relating to the psychological examination of the American troops by officers of the Reserve Army.

Section I (Social and Economic Science), as usual, presented a varied programme, but on the last day of the meeting held a reconstruction symposium, in which several very important papers were read. Dr. David J. Hill, formerly United States Ambassador to Germany, gave an address on "Germany after the War"; M. Edouard de Billy, of the French High Commission, spoke of France after the war; Dr. William H. Welch, of the Johns Hopkins University, spoke of the health problems of reconstruction; Mr. Charles Pergler, Commissioner in the United States of the Czecho-Slovak National Council, gave an address on the future of the Czecho-Slovak State; Sir H. Babington Smith, of the British Embassy, spoke on the reconstruction of Great Britain following the war; and Mr. J. W. Bain, of Canada, on the reconstruction after the war in Canada. Mr. John Barrett, Director-General of the Pan-American Union, who presided at this session, gave an address on the subject of "Pan-Americanism after the War."

The retiring president of the association, Prof. Theodore W. Richards, of Harvard University, was to have given his address at the opening meeting of the session on the subject "The Problem of Radio-active Lead." Most unfortunately, Prof. Richards was seized with "Spanish" influenza when on the point of leaving Boston, and was unable to be present at the Baltimore meeting. The proceedings at the general session were, therefore, brief, and consisted of an address of welcome by Dr. F. J. Goodnow, president of the Johns Hopkins University, and a reply by President-elect Coulter.

The titles of the addresses of the retiring vice-presidents of the sections which met at Baltimore were:—Section A, Prof. Henry N. Russell, of Princeton, "Variable Stars"; Section B, Dr. W. J. Humphreys, of the U.S. Weather Bureau, "Some Recent Contributions to the Physics of the Air"; Section C, Prof. W. A. Noyes, of the University of Illinois, "Valency"; Section D, Dr. H. S. Drinker, president of Lehigh University, "The Need of Conservation of our Vital and Natural Resources as Emphasised by the Lessons of the War"; Section E, Prof. G. H. Perkins, of the University of Vermont, "Vermont Physiography"; Section F. Prof. Herbert Osborn, of the University of Ohio, "Zoological Aims and Opportunities"; Section G, Prof. Burton E.

Livingston, of the Johns Hopkins University, "Some Responsibilities of Botanical Science"; Section H, Prof. E. L. Thorndike, "Scientific *Personnel* Work in the United States Army"; Section L, Prof. E. F. Buchner, of the Johns Hopkins University, "Scientific Contributions of the Educational Survey"; and Section M, Prof. H. J. Waters, of the University of Kansas, "The Farmers' Gain from the War" (Prof. Waters was unable to be present, and the address was not read).

The effect of the meeting on those who attended was inspiring, and the emphasis which the war has placed upon the value of scientific investigation was strongly shown throughout the whole list of papers.

The council arranged for a permanent committee on grants, to consist of nine members, of which Prof. Henry Crew was made chairman, and Prof. Joel Stebbins secretary, both of the University of Illinois. The council, through its committee on policy, also proposed at the general session a complete revision of the constitution of the association, which reorganises and simplifies the work of the association to a very great degree. The full revision will be published in the journal *Science*, and acted upon at the next meeting of the association.

At the meeting of the general committee Dr. Simon Flexner, of the Rockefeller Institute for Medical Research, was made president of the association for the coming year, and St. Louis was chosen as the meeting place, the next meeting to begin on December 29 next. The following officers were also elected:—Vice-presidents (chairmen of sections): Section B, Prof. Theodore Lyman, of Harvard University; Section C, Prof. B. F. Lovelace, of the Johns Hopkins University; Section E, Prof. C. K. Leith, of the University of Wisconsin; Section F, Prof. William M. Wheeler, of Harvard University; Section G, Prof. L. H. Pammel, of the Iowa State College; Section H, Prof. R. M. Yerkes, of the University of Minnesota; Section L, Prof. V. A. C. Henmon, of the University of Wisconsin; and Section M, Dr. A. F. Woods, president of the Maryland Agricultural College. Elections of vice-presidents of Sections A, D, I, and K were postponed to the spring meeting of the council.

Dr. George T. Moore, director of the Missouri Botanical Garden, was elected general secretary, and Prof. James F. Abbott, of Washington University, was elected secretary of the council.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Sir J. J. Thomson has expressed his desire to resign the Cavendish professorship of experimental physics, and at the same time has generously offered to continue his services in the promotion and direction of research work in physics without stipend. It is considered of such great importance for the school of physics that Sir J. J. Thomson should continue to be associated with it as a professor that the syndicate to which the question has been referred recommends that a new professorship without stipend, to be called the professorship of physics, should be established for him. It is proposed that this professorship should terminate with his tenure of the office unless the University should meanwhile determine otherwise. The Cavendish professorship of experimental physics has accordingly been declared vacant, and the election of a professor will take place on April 2. Candidates for the vacant professorship are requested to communicate with the Vice-Chancellor, and to send such evidence as they may desire to submit to the electors on or before Wednesday, March 26.

The election to the professorship of mechanism and applied mechanics will take place on March 28.

Mr. R. A. Peters, of Gonville and Caius College, has been appointed senior demonstrator of biochemistry.

MR. A. J. TURNER has been appointed to the chair of textile technology in the College of Technology, Manchester. Mr. Turner had a distinguished career at Gonville and Caius College, Cambridge, and during the latter part of 1912 he was engaged in research work in organic chemistry at Cambridge under Sir William Pope. He later accepted an appointment upon the scientific staff of the National Physical Laboratory, where he was chiefly engaged in research work on fabrics and dopes for aeronautical purposes. Following this he was appointed to the charge of the fabrics laboratory of the Royal Aircraft Establishment.

A STATEMENT for the year 1918 as to the Rhodes scholarships has just been issued. Only nine scholars were in residence during the year. Of these four had previously been on active service, two had been rejected for service on medical grounds, and three were carrying on their medical studies with a view to early qualification. There were also in residence in the course of the past year fifteen holders of overseas scholarships, granted by the Rhodes Trust and certain other bodies. Of the fifty scholars elected for 1917, forty-six took military service, two were rejected on medical grounds and accepted Government work instead, and two have been otherwise employed. The election of scholars, postponed on account of the war, will be resumed in October of the present year (1919). It is hoped that by that time the demobilisation of the armies will be so far completed that intending candidates who have taken military service will have an opportunity to compete. It is proposed to fill up in October of this year only the 1918 and 1919 postponed scholarships. During the years 1917 and 1918 the organising secretary of the Trust, Dr. G. R. Parkin, visited most of the States of the American Union and the provinces of Canada, and made an exhaustive study, in consultation with university and college authorities, of the operation in those countries of the system pursued in the selection of scholars since the foundation of the Trust. As a result of this investigation certain changes in the methods of selection have been under consideration. Among other changes it has been decided that candidates in the United States who are otherwise eligible shall no longer be required to pass a qualifying examination, but shall be selected, with due reference to the suggestions of Mr. Rhodes, on the basis of their university or college standing, subject to any further test which the committees of selection may, in their discretion, impose.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 27.—Sir J. J. Thomson, president, in the chair.—Hon. R. J. **Strutt**: Scattering of light by solid substances. Glasses of all kinds show a strong internal scattering of light. The beam viewed laterally is strongly, but not completely, polarised. Yellow and smoky quartz also show a strong scattering. One specimen gave a polarisation so nearly complete that an analysis set for minimum intensity transmitted only 0·7 of 1 per cent. of the scattered light. If a polarised beam is passed along the axis of such a quartz crystal, there are for a given wave-length maxima and minima of scattered light along the length of the beam. This is due to the

rotatory property. Owing to rotatory dispersion the period is different for different wave-lengths, and coloured bands result. The clearest and whitest quartz has some scattering power, though much less than that of glass or liquids. In one case examined the intensity was about eight times that due to dust-free air at atmospheric pressure. This small scattering is considered to be due to inclusions, as in the case of visibly smoky or yellow quartz. The regular atomic structure, which has a period small compared with the wave-length of ordinary light, should give no scattering. For very short wave-lengths (X-rays) the well-known diffraction effects of crystals come in.—Sir James **Dobbie** and Dr. J. J. **Fox**: The constitution of sulphur vapour. Investigations based on the determination of the vapour density leave the question of the existence of sulphur molecules intermediate in complexity between S_8 and S_2 unsettled. The present paper contains an account of an attempt to solve the problem by the study of the absorptive power of the vapour of sulphur for light under various conditions of temperature. When light from a suitable source is passed through the vapour and examined with the spectroscope at successively higher temperatures it is found that the amount of absorption caused by the vapour gradually increases up to about 650° C., after which it decreases as the temperature rises until 900° C. is reached, above which no further change occurs.—Dr. W. G. **Duffield**, T. H. **Burnham**, and A. H. **Davis**: The pressure upon the poles of the electric arc. For many reasons the projection of electrons from the cathode of an electric arc is to be expected, and the mechanism of the arc appears to require it. If this projection exists, it is likely to occasion a mechanical recoil upon the cathode. A pressure was looked for in 1912 and discovered. It remained to determine if the magnitude was such as to be accounted for by electronic projection. Numerous sets of observations upon anode and cathode were taken with varying current and arc-length and different dispositions of apparatus. The pressure was found to be about 0·17 dyne per ampere, or when convection current effects were eliminated so far as possible, 0·22 dyne per ampere. The effect does not appear to be due to radiometer action, and is about two hundred times too small to be referred to the expulsion of carbon atoms at the boiling-point of that element. Such evidence as has been obtained thus favours the recoil being due to the projection of electrons.

Physical Society, February 14.—Prof. C. H. Lees, president, in the chair.—S. **Skinner** and R. W. **Burfitt**: Temperature coefficient of tensile strength of water. The liquid is forced under pressure through a capillary constriction between two limbs of a U-tube. By trial the pressure is adjusted until the speed in the capillary is sufficient to produce rupture. This is judged by the sound and also the appearance. The whole U-tube is immersed in a bath, the temperature of which can be varied. Actual observations of rupture, velocity, and temperature are recorded up to about 100° C., from which it is deduced that the tensile strength becomes zero in the neighbourhood of 245° C., which is in agreement with theory.—Prof. W. H. **Eccles**: Vector diagrams of some oscillatory circuits used with thermionic tubes. The method of the crank or vector diagrams used commonly in the study of alternating-current circuits is applied in the paper to the assemblage made up of an oscillator, the thermionic relay maintaining it in oscillation, and the devices linking these two parts. The diagrams then serve as substitutes for the usual treatment of the problem by differential equation, and from them may be obtained all the formulæ. They have, besides, the advantage of exhibiting to the eye the phases of the currents and voltages in every part of the circuits. In forming the diagrams the potential drop across the oscillator is calculated by the usual rules of the alternating-current diagram, and added geometrically to the potential drop across the tube. This total is made equal, in magnitude and phase, to the voltage applied at the instant to the grid multiplied by the voltage factor of the relay. In its turn the voltage applied to the relay depends upon, and is obtained from, the current running in a portion of the oscillator. The fitting together of these lines gives all the conditions to be satisfied for the maintenance of steady oscillations.—Prof. W. H. **Eccles** and F. W. **Jordan**: A small direct-current motor using thermionic tubes instead of sliding contacts. In this motor the rotating part is an ebonite disc with iron teeth on its periphery, and the stationary part comprises two electromagnets with their poles close to two teeth. One electromagnet is connected to the grid of a thermionic relay, the other is included in the plate circuit. When during rotation a tooth passing the grid magnet induces a voltage in its winding, the consequent transient increase of current through the other magnet causes this magnet to exert a pull on the tooth approaching it. We thus have a small motor without commutator or spark which may under no-load be driven up to a speed of 4000 to 6000 revs. per min. from the lighting supply.

Geological Society, February 21.—Mr. G. W. Lamplugh, president, in the chair.—Annual general meeting.—G. W. **Lamplugh**: Presidential address: The structure of the Weald and analogous tracts. (1) The anticline of the Weald is a superficial structure dependent upon an underlying syncline. The lens of sediments thus bounded was deposited in a gradually deepening trough, which was afterwards shallowed by partial recovery. (2) The Jurassic rocks of the rest of England have had a similar history, and show an analogous structure modified by unequal uplift. (3) The Triassic and most of the Carboniferous rocks of England appear also to have been accumulated in deepening troughs or basins, which were afterwards shallowed by differential uplift where the deposits were thickest. (4) Where the formations dealt with lie above sea-level, the present outcrops represent the areas of maximum development, and therefore coincide roughly with the position of the deepest parts of the old troughs. This factor may be of wide application, and has a practical bearing.

February 26.—Mr. G. W. Lamplugh, president, in the chair.—Col. T. W. Edgeworth **David**: Geology at the Western Front.

Zoological Society, March 4.—Dr. A. Smith Woodward, vice-president, in the chair.—G. A. **Boulenger**: Fishes from Lake Tanganyika, including three new species.—Miss Joan B. **Procter**: The skull and affinities of *Rana subsigillata*. Attention was directed to several cranial characters either peculiar to this frog or held in common with *R. adspersa*, its nearest ally.

DUBLIN.

Royal Irish Academy, January 27.—Mr. T. J. Westropp, vice-president, in the chair.—R. Ll. **Praeger**: Species of Sedum collected in China by L. H. Bailey in 1917. The collection included three new species, *S. limuloides*, *S. baileyi*, and *S. quaternatum*, the first being a remarkable plant of doubtful affinities, and the second a member of a group (Involucrata) confined as hitherto known to the Caucasus and Asia Minor.

February 10.—Prof. G. H. Carpenter, vice-president, in the chair.—A. **Henry** and Miss M. G. **Flood**: The history of the London plane, *Platanus acerifolia*. This tree, unknown in the wild state, and invariably

propagated by cuttings, is much planted in the streets of towns in Europe and the United States, where it surpasses all other trees in resistance to evil conditions of soil and atmosphere. It has all the characters of a first cross, its leaves and fruits being intermediate between the two wild species, *P. orientalis* and *P. occidentalis*, while its vigour is remarkable. It moreover produces, when its seeds are sown, a mixed and diverse crop of seedlings, in which are variously combined the characters distinctive of the two parent species. The London plane probably originated as a chance seedling in the Oxford Botanic Garden some time before 1670. Specimens of its foliage, preserved in the Sloane Herbarium at Oxford, were collected by Bobart about that date, and bear the label *Platanus media*, showing that it was then recognised as a hybrid between the Oriental and Occidental planes. This date agrees with the recorded age of the largest London plane known, a magnificent tree at Ely, 110 ft. in height and 23 ft. in girth. Certain cultivated varieties, as *P. pyramidalis*, *P. hispanica*, etc., appear to have originated at a later date as chance seedlings of *P. acerifolia*, as is shown by their history and a careful study of their botanical characters. A complete description of the fruit and leaves of all the species of the genus and of the hybrids is given. The lobing of the leaves, an important character, is measured by a new method.—J. A. **McClelland** and P. J. **Nolan**: The nature of the ions produced by phosphorus. Previous work by the authors and J. J. Nolan has shown the existence of groups of ions of different mobilities produced by spraying water or by bubbling air through mercury or alcohol. The present work shows that similar groups of ions are present in air which has passed over phosphorus. The mobilities range from 0·22 cm. per sec. to 0·000053 cm. per sec. in a field of 1 volt per cm. Drying the air before passing it over the phosphorus brings the more mobile groups into prominence. Three groups of ions of lower mobilities than the atmospheric large ion were observed. The conclusion as to the nature of the phosphorus ions is that they are composed mainly of water.

PARIS.

Academy of Sciences, February 24.—M. Léon Guignard in the chair.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: Some hæmatic phenomena in anaphylaxy and antianaphylaxy. Three new facts are brought out by experiments on dogs. In anaphylaxy the blood is profoundly modified by the appearance of nucleated red corpuscles, by an increase in concentration, and by the disappearance of the polynuclear cells.—A. **Blondel**: Application of the theory of the two reactions to the calculation of the forced oscillations of synchronised alternators.—M. **Balland**: Military soups.—M. Daniel Berthelot was elected a member of the section of physics in succession to the late E. H. Amagat.—A. **Denjoy**: A property of functions with complex variables.—M. **Risser**: Formulæ representative of trajectories.—M. **Mesnager**: Maximum values of the tension near the lower face of a square plate supporting a single load concentrated at its centre.—E. **Faure**: The gyroscopic force of liquids.—A. **Véronnet**: The central temperature of the sun.—A. **Sanfourche**: The oxidation cycle of nitric oxide in presence of water. The oxidation of nitric oxide in presence of water gives nitrous anhydride, and not nitrogen peroxide, as the intermediate product.—E. **Léger**: The α- and β-oxydihydrocinchonines and their *rôle* in the production of certain isomers of cinchonine.—F. **Grandjean**: Some new examples of the calculation of the extraordinary rays for certain structures of anisotropic liquids.—J. **Renaud**: Difficulties met with in the study of storms as a result of the uncertainty of the time of the observations. The change over from Greenwich time to summer time causes difficulty with self-recording instruments, and in several cases it is not clear from the records whether the chart was changed on the date of the change of time.—L. **Joleaud**: The migrations of the genera Hystrix, Lepus, Anchitherium, and Mastodon at the Neogene epoch.—Em. **Bourquelot** and H. **Hérissey**: Application of the biological method to the study of the leaves of *Hakea laurina*. The extraction of a glucoside (arbutin) and quebrachite. By the successive action of invertin and emulsin, these leaves were proved to contain cane-sugar, quebrachite, and two hydrolysable glucosides, one of which, arbutin, was identified.—G. **Petit**: Remarks on the morphology of the phrenic centre of mammals.—P. **Armand-Delille**: Considerations relating to the unicist conception of the hæmatozoa of benign and malignant tertiary fever.—MM. **Boquet** and L. **Nègre**: Infection, sensibilisation, and immunity in epizootic lymphangitis of the Solipeds.—E. **Belot**: The economical organisation of commercial motor transports in a large town.

BOOKS RECEIVED.

Essentials of Volumetric Analysis. An Introduction to the Subject. Adapted to the Needs of Students of Pharmaceutical Chemistry. By Prof. Henry W. Schimpf. Third edition, rewritten and enlarged. Pp. xiv+366. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 7*s*. net.

Integral Calculus. By Prof. H. B. Phillips. Pp. v+194. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 6*s*. net.

Elements of General Science. By Prof. Otis William Caldwell and W. L. Eikenberry. Revised edition. Pp. xii+404. (London: Ginn and Co., 1918.) 5*s*. 6*d*. net.

Agricultural Laboratory Exercises and Home Projects Adapted to Secondary Schools. By Henry J. Waters and Prof. Joseph D. Elliff. Pp. vi+218. (London: Ginn and Co., 1919.) 4*s*. 6*d*. net.

A Century of Science in America. With Special Reference to the *American Journal of Science*, 1818–1918. By Edward Salisbury, Dana, and others. Pp. 458. (New Haven: Yale University Press; London: Oxford University Press, 1918.) 17*s*. net.

Military Geology and Topography. A Presentation of Certain Phases of Geology, Geography, and Topography for Military Purposes. Edited by Herbert E. Gregory. Prepared and issued under the auspices of the Division of Geology and Geography, National Research Council. Pp. xv+281. (New Haven: Yale University Press; London: Oxford University Press, 1918.) 5*s*. 6*d*. net.

A Practical Handbook of British Birds. Edited by H. F. Witherby. In eighteen parts. Part i. Pp. xvi+64+2 plates. (London: Witherby and Co., 1919.) 4*s*. net per part.

Introductory Meteorology. Prepared and issued under the auspices of the Division of Geology and Geography, National Research Council. Pp. xii+150. (New Haven: Yale University Press, 1918.) 4*s*. 6*d*. net.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Thirty-fifth annual issue. Pp. vii+333. (London: Charles Griffin and Co., Ltd., 1918.) 9*s*. net.

The Science of Labour and Its Organisation. By Dr. Josefa Ioteyko. Pp. viii+199. (London: George Routledge and Sons, Ltd., 1919.) 3*s*. 6*d*. net.

La Genèse de la Science des Cristaux. Par Hélène

Metzger. Pp. 248. (Paris: Félix Alcan, 1918.) 5.50 francs.

A Garden Flora. Trees and Flowers Grown in the Gardens at Nymans, 1890–1915. By L. Messel. With illustrations by Alfred Parsons. Foreword by William Robinson. Notes by Muriel Messel. Pp. ix+196. (London: *Country Life* Offices and George Newnes, Ltd., 1918.) 10s. 6d. net.

The Quantitative Method in Biology. By Prof. J. MacLeod. (Publications of the University of Manchester. Biological Series, No. 11.) Pp. xii+228. (Manchester: At the University Press; London: Longmans, Green, and Co., 1919.) 15s. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 13.

ROYAL SOCIETY, at 4.30.—Dr. A. D. Waller: Concerning Emotive Phenomena. III.: The Influence of Drugs upon the Electrical Conductivity of the Palm of the Hand.—Dr. W. L. Balls: The Existence of Daily Growth-rings in the Cell Wall of Cotton Hairs.

ROYAL SOCIETY OF ARTS, at 4.30.—D. T. Chadwick: The Report of the Indian Industrial Commission.

MATHEMATICAL SOCIETY, at 5.—J. Hammond: The Solution of the Quintic.—L. J. Mordell: A Simple Algebraic Summation of Gauss's Sums.—Major P. A. MacMahon: Divisors of Numbers and their Continuations in the Theory of Partitions.—S. Ramanujan: (1) Congruence Properties of Partitions; (2) Algebraic Relations between Certain Infinite Products.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

OPTICAL SOCIETY, at 7.—Major C. W. Gamble: Some Photographic Apparatus used in Aerial Photography.

FRIDAY, MARCH 14.

PHYSICAL SOCIETY, at 5.—C. C. Paterson and Dr. Norman Campbell: Some Characteristics of the Spark Discharge, and its Effect in Igniting Explosive Mixtures.—Major R. W. Wood: Demonstration entitled "Invisible Light for Military Purposes."

ROYAL ASTRONOMICAL SOCIETY, at 5.—J. Evershed: The Spectrum of Nova Aquilæ.—Nautical Almanac Office: Numerical Differences for 1923 between E. W. Brown's Tabular Places of the Moon and the Places according to Hansen; Tables with Newcomb's Corrections.—A. Pannekoek: Distribution of the Stars of the 11th magnitude.—J. Lunt: The Dark Line Spectrum of Nova Aquilæ No. 3.—G. J. Newbegin: Solar Prominences, 1918.—Cambridge Observatory: Photographic Magnitudes and Effective Wave-lengths of Nova Aquilæ.—A. Stanley Williams: Further Observations of Nova Persei (1901).—Royal Observatory, Greenwich: Preliminary Values of Variation of Latitude, 1918.—E. W. Maunder: Notes on Some of the Sun-spots Measured on Photographs taken at the Royal Observatory, Greenwich, in 1915.—*Probable Papers*—J. H. Jeans: The Internal Constitution and Radiation of Gaseous Stars.—A. F. and F. A. Lindemann: Preliminary Note on Some Applications of Photoelectric Photometry to Astronomy.

ROYAL INSTITUTION, at 5.30.—Prof. A. Keith: The Organ of Hearing from a New Point of View.

MALACOLOGICAL SOCIETY, at 7.—A. S. Kennard and B. B. Woodward: *Helix revelata*, Britt. auctt. (*non* Férussac, *nec* Michaud), and the Validity of Bellamy's Name of *Helix subvirescens* in lieu of it for the British Mollusc.—A. Reynell: Forbes's Notes on Loven's "Index."—H. Watson: Notes on *Hygromia limbata* (Drap.).

SATURDAY, MARCH 15.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, MARCH 17.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. W. A. Bone: Coal and its Conservation.

VICTORIA INSTITUTE, at 4.30.—Dr. A. B. Rendle: Bible Natural History.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Lt.-Col. N. M. MacLeod: Survey by Air Photographs.

ARISTOTELIAN SOCIETY, at 8.—A. E. Heath: The Scope of Scientific Method.

TUESDAY, MARCH 18.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: British Ethnology—The People of Scotland.

BRITISH ASSOCIATION GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—Prof. W. H. Bragg and Dr. Crichton Mitchell: The Measurement of Pulsations in the Vertical Component of the Earth's Magnetic Force by means of Horizontal Coils.—Prof. Hubert Cox and Prof. Ernest Wilson: Recent Investigation of the Geological Bearing of Local Magnetic Disturbance in a certain Region.

ROYAL STATISTICAL SOCIETY, at 5.15.—Prof. G. Diouritch: A Survey of the Development of the Serbian (Southern Slav) Race. An Economic and Statistical Study.

MINERALOGICAL SOCIETY, at 5.30.—L. J. Spencer: Curvature in Crystals.—Lieut. A. B. Edge: Siliceous Sinter from Lustleigh, Devon.—Dr. G. T. Prior: The Meteorites Adare and Ensisheim.

ZOOLOGICAL SOCIETY, at 5.30.—H. R. A. Mallock: Some Points in Insect Mechanics.—F. Martin Duncan: Photographs and Lantern-slides of Marine Zoology.—H. F. Blaauw: The Breeding of *Oryx gazella* at Goolust.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—M. A. Ockenden and Ashley Carter: Plant Employed in the Percussion Systems of Drilling Oil Wells.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting), at 7.—R. P. Howgrave-Graham: Oscillatory Electric Discharge.

WEDNESDAY, MARCH 19.

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Dugald Clerk: The Distribution of Heat, Light, and Motive Power by Gas and Electricity.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Prof. Leonard Hill: Atmospheric Conditions which Affect Health.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Dr. J. Bronté Gatenby: An Account of Work on Cytoplasmic Inclusions of the Cell.—Lt.-Col. J. Clibborn: A Standard Microscope.—Dr. Nathan Mutch: A Simple Method for the Isolation of Single Bacteria for the Preparation of Pure Cultures (Demonstration).

THURSDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Prof. C. H. Lees: Fire Cracks and the Forces Producing Them.

LINNEAN SOCIETY, at 5.—F. Lewis: Notes on a Visit to Kunadiyaparawitta Mountain, Ceylon, with List of the Plants Observed and their Altitudinal Distribution.—Miss May Rathbone: Specimens of Plants Preserved by Formalin Vapour.—H. R. Amos: Wheat-breeding with Mr. W. O. Backhouse in Argentina.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Sir Thomas Kirke Rose: The Volatilisation of Gold.—W. S. Curteis: Cobar Stope Measurement Methods.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on G. L. Addenbrooke's Lectures on Dielectrics in Electric Fields.

CHILD-STUDY SOCIETY, at 6.—Discussion opened by Mrs. K. Truelove: Training of th School Girl in Infant Care.

CHEMICAL SOCIETY at 8.

FRIDAY, MARCH 21.

ROYAL INSTITUTION, at 5.30.—Prof. W. W. Watts: Fossil Landscapes.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. C. Armitage: Jigs, Tools, and Special Machines with their Relation to the Production of Standardised Parts.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8, with Royal Society of Medicine (Electrical Section).—R. S. Whipple: (1) Electrical Methods of Measuring Body Temperatures; (2) The Electro-cardiograph.

SATURDAY, MARCH 22.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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THURSDAY, MARCH 20, 1919.

THE VEGETABLE OIL INDUSTRIES.

The Production and Treatment of Vegetable Oils. By T. W. Chalmers. (The *Engineer* Series.) Pp. xi + 152. (London: Constable and Co., Ltd., 1918.) Price 21*s*. net.

THE series of industries which is based on the vegetable oils as raw materials manufactures products which are of the utmost importance to mankind. These industries utilise profitably a very large capital, and in the aggregate give employment to a considerable number of workpeople. They are amongst the most highly organised industries in this country in the application of science to their manufacture, in the enlightened treatment of their workpeople, and in their commercial and financial administration. Consequently the literature, both scientific and technical, dealing with them is a large one, but none the less there is ample room for a book on the somewhat novel lines developed by Mr. Chalmers. He has put together in book form a series of particularly well illustrated articles which appeared from time to time in the *Engineer* during 1917. The subject is treated in a practical manner from the engineer's point of view, and though a certain amount of chemistry is introduced, this is essentially of an elementary character; it is likewise unnecessary, as the chemistry of the subject is fully provided for in existing works.

The vegetable oil industry in this country has received a great stimulus from the conditions brought about by the war. Previously it had developed on international lines; though the raw products came in the main from British Colonies, they were dealt with largely at Hamburg or Marseilles and further elaborated in Holland, only soap-making being an essentially British industry. Now all branches are firmly established in this country, and unless their growth is hampered by unwise legislation and taxation, a contingency which is not altogether impossible, they are likely to prove a great national asset.

The method adopted by Mr. Chalmers is to give a detailed description in simple terms of the processes in use throughout the industries from the raw materials to the finished products. He has succeeded in making this sufficiently detailed to be of considerable value to those engaged either in the particular section or in one of the allied sections of the industry and thus already possessing a general knowledge of the subject, as well as to others outside the industry who may wish to understand it. With such a work, criticism of details is largely a matter of opinion and therefore unnecessary; but on the general question it is perhaps a matter for regret that the author has drawn his experience of the machinery he describes and illustrates from a very limited number of firms, thereby to some extent misleading the reader as to the alternative plant available.

The earlier chapters deal with the preparatory machinery for the nuts and seed before they enter the oil mill proper and that required afterwards to prepare them for the presses or extraction vessels. Oil presses of both the Anglo-American and Cage types are described, these sections being particularly well illustrated. A useful chapter discusses the general arrangement of oil mills of both types.

A very good account is given of the solvent extraction process, which, of course, has a wide field of application outside the vegetable oil industry. The cake from the oil presses contains somewhere about 8 per cent. of oil and is recognised as a very valuable food for cattle; the residual meal from the solvent process contains only about 1 to 2 per cent. of oil, and has to be carefully steamed to get rid of the last traces of solvent. The early imperfect working of this process has caused a prejudice against the meal in the minds of farmers which is to-day entirely unjustified. Furthermore, it is generally stated that extracted oil cannot be refined for edible purposes, though this is entirely contrary to experience. The author lays stress on the fact that recent progress has overcome the objections to the solvent process, and that pressing and extraction can be very profitably worked side by side in the same mill.

The refining of oils so as to make them edible is a subject concerning which much secrecy is usually exercised; the industry has been very much developed in Britain during the last few years, and we should now be entirely independent of the Continent for edible oils.

The manufacture of margarine is omitted, and the author passes to another section of the industry, that of oil-hardening, or hydrogenation. Most of the vegetable oils are too liquid to be used for soap-making or even for edible purposes; this is due to their being unsaturated—that is, they contain an insufficient proportion of hydrogen. This element may be introduced into the molecule by means of a nickel catalyst, whereby a liquid oil can be converted into a solid oil of any desired degree of hardness. The process is full of technical difficulties, and their practical solution, so as to give a thoroughly efficient commercial process, is one of the best achievements of the English chemical manufacturer during the last twenty years. It is worth recalling that but for this process there would have been no soap and very much less margarine during the last two critical years.

The problem of the technical manufacture of hydrogen on a large scale had also to be solved before hardening could be carried on commercially. The author deals with these two subjects in considerable detail and imparts much information which has not hitherto been published.

The final chapters describe the manufacture of soap, perhaps the best known part of the industry, and with the recovery of the glycerine from the soap lyes. As the soap industry has been worked mainly for the sake of this by-product during the

war, considerable interest attaches to its efficient recovery.

The author is to be commended on a solid piece of work, which cannot fail in the long run to be of much use to the vegetable oil industries.

E. F. A.

TEMPERATURE IN CHINA.

La Température en Chine et à quelques Stations voisines d'après des observations quotidiennes. Compilées par H. Gauthier, S.J. 3 vols. Pp. xlviii+784. (Shanghai: Imprimerie de la Mission Catholique, 1918.)

SINCE the publication of Buchan's comprehensive "Report on Atmospheric Circulation," the accepted unit of time in the compilation of climatological data has been the month, and daily averages of meteorological elements have rarely been calculated. The inadequacy of monthly, and the need for daily, normals have often been urged, but the preparation of the latter requires considerable leisure, a rare commodity in most meteorological services.

The present set of three volumes provides daily averages of temperature for China and its vicinity in the most complete and satisfying manner, dealing with one hundred stations, for periods varying from one to forty-four years. The data have been prepared by Father H. Gauthier, S.J., director of the meteorological observatory of Zikawei, which is also the headquarters of the meteorological service of China. The work was obviously a labour of love, from the completeness of the tables and the full discussion. The volumes contain a long and interesting introduction, a set of charts of monthly and annual isotherms of China, with other diagrams, and 784 pages of tables. The introduction alone is a valuable treatise on the climate of China, containing a full discussion and analysis of all elements at Zikawei, including some, like ozone, not generally dealt with, and also a summary of the changes in the meteorology of China month by month.

The harmonic analysis of the annual variation of the meteorological elements at Zikawei suggests a study of the influence of various factors —insolation, pressure, wind, evaporation, etc.—on the temperature. The annual curve is built up, step by step, from these data in a very instructive way by the gradual modification of the symmetrical curve due to heat supplied by the sun as each additional factor is brought in. The final result is to obtain a very close approximation to the mean temperature of each month, and the procedure is repeated with almost equal success for other stations—Irkutsk, Peking, and Hong Kong—for which, however, the author has to bewail the absence of important data like the figures of evaporation.

Other notes on the geographical factors influencing temperature follow, but the *raison d'être* of the book is the set of tables. Of these, 730 pages are devoted to the daily averages of temperature at one hundred stations arranged in order of latitude, each day occupying two pages. The details given include the raw daily means, the same corrected for altitude and also smoothed, the mean and extreme maxima and minima, and the daily range. Corresponding figures are given for 1916 alone.

The author refrains from drawing elaborate conclusions from the figures, but contents himself with laying them before the meteorologists of the world as a contribution to the knowledge of a country long, but erroneously, considered as meteorologically unexplored. He points out, however, the value which such a set of data has for the study of the connection between solar heat and the annual variation of temperature. There are, indeed, a number of problems clustered round this point which can be solved only by a study of the daily means of temperature—for example, the cold spells of spring and the warm spells of autumn. The reality and periodicity of these—the Ice Saints and the Indian summer—can be determined only by a study of daily averages. The tables, for instance, appear to show that over the whole seaboard of China there is a quite decided lapse of temperature between June 4 and 11, and there are possibly others which would be revealed by a detailed study. Another problem is the incidence of the monsoon in China, in which, of course, temperature is the ruling factor. The details of the complete reversal of type from the cold, dry, anticyclonic conditions of winter to the maritime conditions of summer, and still more the reverse changes from summer to winter, cannot be brought out entirely by monthly charts. For example, those of August and September in Middle China show a reversal of type from the land warmer than the sea to the land colder than the sea, with a corresponding change in the predominant wind direction, and the intervening period of transition, which is not without interest, is unrepresented until the daily charts are drawn.

The progress of the seasons is further illustrated by marginal notes of a phenological nature, especially dealing with the migration of birds, and by meteorological details showing the conditions under which extremes have occurred. It appears that there is a tendency for individual days to be hot or cold over a large extent of eastern Asia. The cold days occur, as one would expect, with large and intense areas of high pressure in the north or north-west of China, while the warm days occur in the presence of depressions, especially when the latter are so situated that they cause south-easterly winds in winter or south-westerly winds in summer; thus the great heat-waves occur when shallow depressions, not sufficiently intense to cause great cloudiness, pass north-east of Shanghai.

The author expresses his conviction that the value of his work will rise above its possible deficiencies. That conviction is certainly justified, but may one add a hope that, in the full volume of plates which is promised to accompany the tables, the printer will succeed in making the denominations of the isotherms more legible?

C. E. B.

OUR BOOKSHELF.

Tables of Refractive Indices. Vol. i. "Essential Oils." Compiled by R. Kanthack. Edited by Dr. J. N. Goldsmith. Pp. 148. (London: Adam Hilger, Ltd., 1918.) Price 15*s.* net.

THIS volume is the first of a series, in which it is proposed to publish the values of the refractive indices appertaining to various technical products.

Used with discretion, the refractive index is a property which will often give valuable information as to the purity of a liquid, and it is a property which is readily determined. Another advantage is that, given a suitable refractometer, a very small quantity of the substance suffices for the determination. In examining essential oils the value of the refractive index is a very useful *datum*, and it is convenient to have the numerous recorded observations, hitherto scattered over the literature, selected, scrutinised, and brought together in a handy form such as that of the book before us.

The data which Mr. Kanthack has collected are arranged in tables occupying the right-hand pages of the book, the opposite pages being left blank for notes. In the first column of the table are the names of the oils in alphabetical order, with their botanical origin, and often their geographical source also. Then follows the refractive index, the temperature of the observation being given in every case. With respect to this last point, abstractors of chemical literature would do well to note the author's remarks upon the futility of stating a refractive index unless the temperature of the observation is also given. Finally, there is a reference to the authority, and this will be found an important feature, because there are some two hundred and eighty of these references, and they form a good guide to the literature of the subject. In fact, some of the index-values, which would otherwise be redundant, have been purposely utilised for introducing references to important work or special information. Chemists who are concerned with the examination of essential oils will find the book decidedly helpful.

An Introduction to the Study of Biological Chemistry. By Prof. S. B. Schryver. (Modern Outlook Series.) Pp. 340. (London: T. C. and E. C. Jack, Ltd., n.d.) Price 6*s.* net.

THE author is to be congratulated on a very useful addition to chemical literature. The special feature of the book is a careful choice of examples which are of peculiar interest to students of biological chemistry. The first 178 pages are devoted to a description of general chemical methods, and to a study of the chief groups of organic substances; and, while no attempt has been made to give full details of the properties of the individual compounds, a succinct account has been given of the relationships between the various groups.

A specially good feature is the inclusion of, and the prominence given to, synthetic methods, and careful accounts are given of Grignard's reaction, Friedel and Crafts' reaction, the malonic ester reaction, Kiliani's reaction, and Sandmeyer's reaction, as illustrative of general synthetic methods. A very useful chapter deals with optical activity and the chemistry of stereoisomerism. The treatment of the aromatic substances is brief, but sufficient for the purposes for which the book is intended. The remainder of the book is devoted to the study of the chief chemical constituents of the animal body, and the chemistry of the fats and carbohydrates is given in more detail than is usual outside special monographs. To the student of bio-chemistry the constitution and properties of the proteins are questions of fundamental importance, and have been fully treated. The purely chemical part of the book is completed by special chapters on the methods employed for the investigation of the chemical changes within the animal organism, and on the chemical processes in plants. In these chapters the main features of enzyme action are dealt with, and the nature of the changes which occur during the intermediate metabolism of the foodstuffs is discussed.

In conjunction (as the author suggests) with suitable practical exercises worked in the laboratory, the book should prove very useful, and forms an excellent basis for the preliminary training of medical students or of agricultural students in those lines of thought which are of service to them. The book is tersely and continuously written, each chapter carefully summarised, and an efficient index is provided.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Globular Clusters, Cepheid Variables, and Radiation.

I WAS much interested to see in the letter by Dr. Harlow Shapley bearing the above title (NATURE, March 13, p. 25) that new astronomical evidence makes it necessary again to challenge the almost universal assumption that radiation is uniformly propagated in all directions through free space. I have long felt that this unjustifiable assumption was at the bottom of the difficulty of accounting for the maintenance of solar and cosmical energy even over the periods of time demanded by geological history, and I have often thought that, even though no actual crucial test is possible, experimental evidence on such an important question ought to be attempted. In a review of Dr. N. R. Campbell's "Modern Electrical Theory" (NATURE, vol. xcii., p. 339, 1913) I pointed out that experiment and observation justify only the conclusion that radiation is propagated between portions of space occupied by matter, and that elsewhere it may not be propagated at all. The frank confession of complete ignorance on this, the simplest first question as to the nature of radiation in its cosmical aspect, would put an entirely different complexion on the doubtful generalisations from laboratory science to cosmology. As Dr. Shapley calculates with regard to solar radiation, the ordinary assumption demands a loss of energy one hundred million times greater than experimental evidence justifies.

FREDERICK SODDY.

Graphical Methods in Nautical Astronomy.

As the author of the article in NATURE of October 24, 1918, in which the diagram referred to by Dr. Hutchinson last week was first brought to the notice of your readers, may I be permitted to supplement the information as to previous efforts in the same direction? When the diagram first appeared in this country Rear-Admiral Parry, Hydrographer to the Admiralty, also set on foot an inquiry similar to that of Dr. Hutchinson, and very courteously sent me the result of his investigation. From his report it appears that "an account of the 'Nomogramme' was published in *Petermann's Mittelungen* (vol. ii., pp. 182 and 249, 1913), and was illustrated by a skeleton diagram similar in principle to these charts, and the method for using it was fully explained." This, in point of time, is fifteen years later than the date of the paper of M. d'Ocagne, who, so far as appears at present, is clearly entitled to the credit claimed for him as first in the field.

The share of Mr. Littlehales, however, is marked by two features of interest:—(1) That he seems to have been the first to prepare and publish the diagram in a form that promises to be useful in the navigation of air and ocean, and (2) that the simplicity of treatment which deduces the principle and graduation of the chart directly from a general formula of spherical trigonometry renders the theory of the matter intelligible to many nautical persons to whom the mysteries of "Nomographie" are as a sealed book. H. B. GOODWIN.

March 15.

The Oldest Mosquitoes.

THE REV. PETER BELLINGER BRODIE, in his "History of the Fossil Insects of the Secondary Rocks of England," gave a figure of a small fly which he named *Culex* (?) *fossilis*. This insect, from the Purbeck strata, would be by far the oldest mosquito known, were it a veritable Culex. Unfortunately, it is impossible to form any definite opinion, and as positive evidence of the antiquity of the Culicidæ the specimen must be dismissed as valueless. On general grounds it is very improbable that the group is so ancient. In Handlirsch's great work on fossil insects several Culicidæ are listed from the Oligocene Tertiary; but Handlirsch did not know that two species described by Scudder, from Wyoming and Utah respectively, are actually much older, coming from Eocene rocks. The one from Utah is of little value, and presumably not a true Culex; but that from the Green River beds of Wyoming has the unmistakable features of a genuine mosquito, showing the long proboscis and the short palpi of the female. According to Schuchert's estimates of geologic time, this should be more than two million years old at the very least. Scudder's insect, called *Culex damnatorum*, is 6 mm. long, with a proboscis 1·9 mm. It doubtless tormented the Eohippus and related mammals of this general period. Whether it carried any pathogenic protozoa we can, of course, never know. It is now possible to put on record a second Eocene mosquito, found by Mr. Dean E. Winchester, of the U.S. Geological Survey, at Smith's Ranch, in the vicinity of the Cathedral Bluffs, in western Colorado. It is represented by a female, preserved in lateral view, 5·2 mm. long, the wing about 4·2 mm., thorax about 2 mm., palpi about 0·4 mm., and the distinctly curved proboscis 3 mm. The stout abdomen is like that of true Culex, obtuse at the end, not tapering as in Aëdes. The longer proboscis readily separates it from Scudder's insect, so it must stand as a new species, to be called *Culex winchesteri*, after its discoverer. The horizon is considered to be Green River, approximately equivalent to that of the Wyoming locality.

The oldest British mosquitoes, setting aside Brodie's very dubious Purbeck specimen, are three species from the Oligocene of Gurnard Bay, in the Isle of Wight, also collected by Brodie. These were described by the present writer in 1915, and are in the U.S. National Museum. One of them is so beautifully preserved that it shows the wing-scales.

While writing on fossil Diptera I take occasion to note that my *Mesomyites concinnus*, another of the Gurnet Bay fossils, is evidently a member of the peculiar Tipulid genus Styringomyia, and should be called *Styringomyia concinna*. I am indebted to Mr. C. P. Alexander for suggesting the correction. The specimen is in the British Museum.

The Gurnard Bay locality, which furnished Brodie with large and important collections, seems not to have been investigated in recent years. Most of Brodie's collection is at the British Museum, and will, when fully described, add greatly to our knowledge of Tertiary insects. T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado.

Proposed Magnetic and Allied Observations during the Total Solar Eclipse of May 29, 1919.

SPECIAL magnetic and allied observations will be made at certain stations inside and outside the shadow belt of the total solar eclipse of May 29 next by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and by various magnetic observatories, institutions, and individuals. The probable stations of the Department of Terrestrial Magnetism are (1) La Paz, Bolivia; (2) Huancayo (north of belt of totality); (3) near Sobral, Brazil; (4) Ile Principe or Libreville, French Congo; and (5) various field stations within the zone of visibility. At station (3) complete magnetic and electric observations will be made.

The general scheme of work proposed by the Department of Terrestrial Magnetism is as follows:—

(1) *Simultaneous magnetic observations* of any or all of the elements, according to the instruments at the observer's disposal, every minute from May 29 next, 9h. 58m. a.m. to 4h. 32m. p.m. Greenwich civil mean time, or from May 28, 21h. 58m. to 4h. 32m. May 29, Greenwich astronomical mean time.

(To ensure the highest degree of accuracy, the observer should begin to work early enough to have everything in complete readiness in proper time. Past experience has shown it to be essential that the same observer should make the readings throughout the entire interval. If possible, similar observations for the same interval of time as on May 29 should be made on May 28 and 30, to afford some means of determining the undisturbed course of the magnetic declination.)

(2) *At magnetic observatories* all necessary precautions should be taken to ensure that the self-recording instruments will be in good operation, not only during the proposed interval, but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient.

(It is recommended that, in general, the magnetograph should be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible should be taken to guard against instrumental changes likely to affect the continuity of the base line.)

(3) *Atmospheric-electric observations* should be made to the extent possible with the observer's equip-

ment and *personnel* at his disposal. At least observations of potential-gradient and conductivity (preferably both positive and negative) should be made.

(4) *Meteorological observations* in accordance with the observer's equipment should be made at convenient periods (as short as possible) throughout the interval. It is suggested that at least temperature should be read every fifth minute (directly after the magnetic reading for that minute).

(5) *Observers in the belt of totality* are requested to take the magnetic reading every thirty seconds during the interval, ten minutes before and ten minutes after the time of totality, and to read temperature also every thirty seconds before the magnetic readings.

It is hoped that full reports will be forwarded as soon as possible for publication in the journal *Terrestrial Magnetism and Atmospheric Electricity*. Those interested are referred to the results of the observations made during the solar eclipse of June 8, 1918, the publication of which was begun in the September (1918) issue of the journal. A summary of the results obtained is given in the March (1919) issue.

LOUIS A. BAUER.
Carnegie Institution of Washington, Department of Terrestrial Magnetism, Washington, D.C., February 15.

A Proof that any Aggregate can be Well-ordered.

ALL the critics of my method sketched or described in my two letters to NATURE (vol. ci., pp. 84 and 304, 1918), in my two notes in *Comptes rendus* (vol. clxvi., pp. 520–23 and 984–86, 1918), in *Mind* for July, 1918, and in *Science Progress* for October, 1918, wish to see a certain particular case solved in detail. Although this case does not throw so much light on the problem as the equally simple method of dealing with the general case, which I happen to have discovered long before I applied it to special cases, I here give the treatment of the particular case referred to.

Suppose that an aggregate M is such that there are classes x_1, x_2 . . ., where x_n is the class of all those chains of M of type n, and the suffixes of the x's are all the finite ordinal numbers (that is, those less than ω); we are to prove that M has a chain of type ω. We will define by complete induction a rule for actually constructing out of the x's *many* (we can prove afterwards that the *many* are *all*; we do not, of course, merely postulate that there is a non-null class of all such classes) classes of direct continuations of which each contains one chain from each x. The rule, though it is, accordingly, split into two parts, is to be regarded as one whole; and it can be so regarded, since it does not involve an infinity of arbitrary selections.

(1) With each member K_2 of x_2, class that member of x_1 which is the sole segment of K_2. Thus each member of x_1 is classed with many of x_2, and each member of x_2 is classed with a definite one of x_1 so that together these members form a class of direct continuations with members of types 1 and 2.

(2) In general, for $2<n<\omega$, with each member K_n of x_n classify (*a*) that member (K_{n-1}) of x_{n-1} which is a segment of K_n, and (*b*) also those chains of types $n-2$, . . . 2, 1 previously classed with K_{n-1} by the rule. Remember not to regard here a class of y and z as anything more than just y and z. For instance, each member of x_3 forms, with the chains classed with it, a class of direct continuation with three members; and we easily see that, in general, every class of direct continuations with n members is added to, provided that the whole rule is applied and not merely a part of it which stops at n.

Thus we have defined a means of rearranging all the members of all the x's so that they form classes of direct continuations of the kind we wished and stated above. Since any class of *direct continuations* which is formed from the members of M, and contains chains of all types less than ω, plainly defines a chain of type ω, each of the classes of direct continuations formed by the rule defines a chain of type ω. This is what we had to prove. We have, indeed, a set of classes of direct continuations such that each class has at least two terms, and, if it has n terms, it has $n+1$.

PHILIP E. B. JOURDAIN.
The Bourne, Basingbourne Road, Fleet, Hants, March 11.

Coal in Thrace.

ANTIGONOS, a Greek writer about the beginning of our era, made a collection of the accounts of the natural wonders of his time. Among them he mentions—I translate from the Greek edition of 1568—that "they say that in the wild (uncultivated) region of Thrace there is a river called Pontos, which brings down in its course stones resembling *anthrax* (charcoal), and that these burn, but differ in combustion from charcoal, inasmuch as the use of bellows extinguishes the fire. On the other hand, sprinkled with water they burn all the better." Where was this river? Kiepert does not mention it, but it seems to have flowed into the Black Sea, then called Pontos. It would be interesting to know if anthracite has been found so near Constantinople.

EDMUND M'CLURE.
80 Eccleston Square, S.W.1, February 27.

THERE is no warranty for suggesting that "stones resembling anthrax" are anthracite; they are far more likely to have been bituminous coal or lignite, both of which burn more readily than does anthracite, which latter is decidedly difficult of ignition. Whilst European Turkey has not been fully explored for coal, the existence of coal is known in various places; a bituminous coal-seam is reported near Keshan, in the province of Adrianople, and along parts of the northern coast of the Sea of Marmora; and there are lignite deposits known near Rodosto, near Dedeagatch, and even within a short distance of Constantinople. Obviously any of these deposits might have given rise to the stones referred to by Canon M'Clure.

It would be interesting to know whether the Greek text excludes the possibility of its reference being to the district of Pontos, on the south shores of the Black Sea, as the best-known coal-mines of all the region are those to the south of Heraclea in that district.

HENRY LOUIS.
Armstrong College, Newcastle-upon-Tyne, March 3.

Curious Markings on Chalk.

DR. ANDREWS (NATURE, March 13, p. 25) probably knows more about the natural forms assumed by chalk than I do, but I think, nevertheless, that the specimen described by me in the February issue of *Man* (p. 17, pl. B) cannot be disposed of quite so summarily as he supposes. And I would suggest that it is generally considered unwise, in such matters, to publish a definite opinion before an examination of the actual specimen has been made.

It is my hope that before long Mr. Gathorne-Hardy may exhibit his discovery at a meeting of

some learned society where those interested will have the opportunity of making such an examination.

J. REID MOIR.

One House, Ipswich.

Protozoal Parasites in Cainozoic Times.

IN the issue of NATURE for October 3, 1918 (p. 95), which has just reached me, is a note on Prof. T. D. A. Cockerell's discovery of two new species of Glossina in the Miocene shales of Colorado. It is said that "Osborn's suggestion that many large Cainozoic mammals in America may have been destroyed by fly-borne parasites is rendered highly probable by the wider range of tsetse-flies now indicated by Prof. Cockerell."

I do not see that the conclusion is justified. The co-existence in space and, possibly, time of a species of blood-sucking fly and certain large mammals affords no grounds for concluding that protozoal parasites carried by the former destroyed the latter. Do blood-sucking flies in America at the present day destroy wild animals through the medium of the Protozoa they carry?

I am unaware of any evidence at present that wild animals in Africa are destroyed by the Trypanosomes of which they are the hosts and Glossina the vector; indeed, there is very definite evidence to the contrary that buck do not suffer in the least from the continued presence in their blood of Trypanosomes which are pathogenic to man and his domestic animals.

What grounds, then, are there for the assumption that the adaptation of such Protozoa to their hosts was any less perfect in Cainozoic times than at present?

G. D. HALE CARPENTER,
Uganda Medical Service.

Kome Island, Lake Victoria, January 12.

THE PERU-BOLIVIA BOUNDARY COMMISSION.[1]

THE search for a scientific frontier has taken men into many wild and unexplored regions of the earth's surface, and has, in the aggregate, helped in the accumulation of no mean amount of new geographical knowledge. Those familiar with the true foundations of the map of Africa know well that in many areas the surveys executed by boundary commissions are still the only authorities for geographical positions, and that the boundary surveyor was often the first white man to force his way into hitherto unknown parts. As, further, the surveyor brings with him both the equipment and the trained technical skill necessary to garner the very utmost amount of detailed and trustworthy information in the course of his rapid traverse of the country, it follows that, next only to the closely settled districts, the boundary lines in Africa are now the best known regions of the continent.

FIG. 1.—Cojata Pampa, wind-eroded rocks. From "Peru-Bolivia Boundary Commission, 1911–13."

The conditions in South America are somewhat similar, but, owing to the fact that most of the international boundaries are almost inaccessible, lying either on the great heights of the Andine Cordillera or hidden in the impenetrable forests of the Upper Amazon and its tributaries, the need for actually defining these frontiers on the ground has not generally

[1] "Peru-Bolivia Boundary Commission, 1911–13." Reports of the British Officers of the Peruvian Commission. Edited for the Government of Peru by the Royal Geographical Society of London. Pp. xi+242+maps. (London: Cambridge University Press, 1918.)

arisen as yet, except in places where the discovery of mineral wealth has compelled such definition. In the case of the Peru-Bolivia boundary, however, though evidences of rich mineral deposits are found by the most casual explorer, it was not the mineral so much as the vegetable wealth which was the final determining cause inducing the States concerned to attempt the settlement of a dispute dating back to their foundation. The rise in the value of rubber, the exhaustion of the more readily accessible rubber forests, and the consequent pushing out of the rubber-collector into more and more remote fastnesses, brought forward the question of this boundary, running for a large part of its length through either actual or possible rubber-bearing forest, as one imperatively demanding a final solution.

We may remark in parenthesis that there is another source of natural wealth, scarcely seriously taken into account yet, but which will have a vital influence on the future of civilisation, and with which boundary surveys, especially such as lie in mountain regions, are most intimately concerned. The wealth in question is that of natural sources of water-power. What the aggregate horse-power now running to waste off the gigantic mountain system of the Andes amounts to is beyond the range of human conjecture, but we may safely predict that within at most a generation or two this power will be of enormous, realisable value. Boundary agreements of the future may have to pay special attention to this point.

It would be out of place to recount here the successive steps that led up to the appeal by the States concerned to the Royal Geographical Society to nominate officers to carry out the survey and demarcation, fully set forth in the volume under review. The work was almost completed in 1914, when the officers engaged were, of course, recalled for service. Two of them fell in the early months of the war, and as the others were still engaged on service, and no date could be fixed for their release, it was decided in 1917 that the preparation and publication of their report should be undertaken by the society under the editorship of Sir T. Holdich, assisted by Mr. Arthur Hinks. The splendid volume before us is, therefore, due to the able labours of these editors, assisted in a large measure by the very excellent and exhaustive records kept by the members of the commission. We may safely say that no boundary has been described with more completeness, and it is to be hoped that this volume will form a model for the future. Our knowledge of Africa, for example, will advance by rapid strides if the demarcation of the new boundaries, presumably called for within the next few years, results in any comparable addition to our geographical knowledge, and is recorded in a volume of such permanent interest.

In one point the Peru-Bolivia commission was exceptionally fortunate in that one of its members,

FIG. 2.—Calijon from the Rinconada Glacier. From "Peru-Bolivia Boundary Commission, 1911–13."

Major Toppin, was a trained naturalist, and was able to make the most of his opportunities. Several new butterflies and a new monkey were the permanent testimonials to his skill. One is rather inclined to lament that it is not always possible to take the opportunity of a boundary survey and, by attaching, say, a naturalist, a geologist, and possibly a botanist to the commission, gain much knowledge without great cost. Doubtless this practice might be often followed, but it must be remembered that a boundary commission is always in a hurry; it never has enough time to carry out all the survey observations it would like, and routes, times, and halting-places must be regulated solely by survey considerations. It would, therefore, often result that the naturalist or geologist would have to leave almost untouched the regions most fruitful of promise for him, and might return from the expedition with feelings of disappointment at opportunities missed.

We have no space here to enter upon any close discussion of the technical points raised in this report. The survey was of the class already familiar in similar undertakings, and was subject to the same obstacles as those found in previous surveys, both in high mountains and in dense forests: the difficulties of transport, the prevalence of mist and cloud, the impossibility of getting distant views from the constricted valleys, and, in the forest portion of the line, a horrible abundance of malignant insects. Once again, possibly for the last time, an effort was made to determine longitudes by occultations, a method which cannot attain the precision requisite for such work, and should be entirely superseded by wireless signals, which can now be received upon instruments of almost any desired degree of portability. In any case, astronomically determined positions are of little value as a check upon a triangulation even of the second order, and are of more interest to the geophysicist than to the boundary surveyor. This commission was fortunate in finding a well-established initial point for the astronomical work in the observatory at Arequipa, the southern station of the Harvard College Observatory.

An interesting little note by Sir C. Close is embodied in the report discussing the gravity deflections in the boundary region, and showing that the local attractions are quite similar to those found in the region of the Himalayas near Mussoorie and Dehra. The volume, produced in the accustomed high standard of the Cambridge University Press, is furnished with all the necessary maps and a rich selection of illustrative plates. We can heartily commend it, both to the reader of the present day as an account of a highly successful piece of geographical survey, and to the reader of the future as an imperishable record of the work that can be accomplished, in spite of innumerable difficulties and in face of great natural obstacles, by a small but thoroughly proficient British survey party.

E. H. H.

THE AIR FORCE ESTIMATES AND AERONAUTICAL RESEARCH.

THE development of military aviation has been one of the wonders of the war, but we have naturally been kept somewhat in the dark as to the exact extent of such development while the war was still in progress. The veil has now been lifted, and Gen. Seely, in speaking on the Air Estimates in the House of Commons on March 13, has given us a striking summary of the progress made during the past four years. The fact that the expenditure on the Air Force has increased two-hundred-fold since the outbreak of hostilities is a sufficient comment on the enormous advances that have taken place in the aeronautical world. Gen. Seely states that if the armistice had not been signed, this year's Estimates would have reached the sum of 200,000,000*l.*—an amount which is practically four times our pre-war expenditure on the entire Navy! Even with the signing of peace in sight the sum of 66,500,000*l.* is asked for, in order to ensure the maintenance of the aerial supremacy which we have gained during the war.

It is exceedingly gratifying to note that the true value of research is at last being appreciated, and the specific provision of 3,000,000*l.* for "civil aviation, experiments, and research" will be welcome news to those who hope for the scientific development of commercial flying. Gen. Seely further points out that this sum does not by any means represent the total amount that will be spent on research beneficial to the civilian aviator, since the results of experiments carried out for military purposes and paid for out of the Army Estimates will be equally available for the improvement of commercial machines.

The Government has decided that it cannot itself undertake commercial flying, but that it will do everything in its power to give encouragement and protection, and it is already announced that the Postmaster-General is prepared to give contracts to private firms which are able to offer approved machines for postal services. Moreover, the Government will place most of the military aerodromes of the country at the disposal of civilian pilots for a small fee, and this alone should do much to encourage civilian flying.

In the course of his speech Gen. Seely announced that an important invention in wireless telephony had recently been made, by means of which the wireless operator in an aeroplane was able both to send and to receive messages. It was possible during the war for the leader of a scouting aeroplane squadron to communicate with the others, but it was not practicable to receive an answer. A vacuum valve generator was employed to generate smooth oscillations in the hanging aerial, and a vacuum valve magnifier with a crystal rectifier was used as the receiver. The experimental apparatus was in use in pre-war days, but it required years of research to make it practical and trustworthy. We congratulate the

Air Board research department on having overcome all the difficulties.

The promise for the future of aviation is very bright, and the recognition of the necessity for continuous research in the development of both military and civilian aeronautics leaves little doubt that the resources of scientific investigation, which have been of incalculable value during the war, will be fully employed in the solution of the problems of the future.

LUDVIG SYLOW.

THE death of Ludvig Sylow (September 7, 1918), at the age of eighty-five, has removed an eminent mathematician, whose career was in many ways remarkable. Sylow's seventh published paper ("Théorèmes sur les groupes de substitutions") occupies less than ten pages in vol. v. of the *Mathematische Annalen* (1872); this contains the proof of his justly celebrated theorem about groups, which has perhaps done more than any other single proposition to advance our knowledge of groups in general. In spite of this great achievement, Sylow had to earn his living as a secondary-school teacher until he had served a term of forty years. Recognition came at last; he was made professor at Christiania at the age of sixty-five, and filled the chair successfully for twenty years.

It may be of interest to recall Sylow's own statement of his theorem: "Si n^a désigne la plus grande puissance du nombre premier n qui divise l'ordre du groupe G, ce groupe contient un autre g de l'ordre n^a; si de plus $n^a v$ désigne l'ordre du plus grand groupe contenu dans G dont les substitutions sont permutables à g, l'ordre de G sera de la forme $n^a v(np+1)$." It should be noted that Sylow gives a proof that, if n^a is the highest power of n contained in the order of G, then G contains a subgroup of order n^a.

Sylow wrote a number of other papers, dealing with such topics as group-theory, solution of equations by radicals, elliptic functions, modular functions, etc. In collaboration with Lie he undertook the arduous task of editing the second issue of Abel's works. In this the misprints and oversights of the original edition are corrected, and a number of valuable notes and comments by the editors are added.

G. B. M.

NOTES.

THE appointment of Dr. S. F. Harmer to succeed Sir Lazarus Fletcher as director of the Natural History Museum, South Kensington, is a happy solution of the question raised by the letter from twenty-three naturalists published in NATURE of March 6, and commented upon by us in the same issue. Dr. Harmer has been keeper of the Department of Zoology of the museum since 1907, and he will retain this position until the end of next year. During this transition period Mr. C. E. Fagan, the assistant secretary, will assist him in the control of the museum, and, in recognition of his valuable services, will occupy a considerably improved position on the staff. Mr. C. Tate Regan has been appointed assistant keeper of zoology in succession to Mr. W. R. Ogilvie Grant, who has retired. As the Trustees have appointed a distinguished naturalist to the directorship of the museum, the series of eminent scientific men who have occupied that post remains unbroken. It is the duty of men of science to guard jealously their claims to direct the affairs of scientific institutions, and to protest when any encroachment upon them is contemplated. In the present instance Mr. Fagan was more than a purely lay administrator, and his scientific services have been appropriately recognised by the Trustees. The tendency is, however, to place lay administrative officers in control of State institutions concerned with scientific work, on the ground that a man of science cannot be a good administrator. Even if this general belief, cherished in the Civil Service, could be justified—and we do not accept it for a moment—the highest office in a scientific institution should be held by a scientific man, and not by a lay official. That is the whole point of our contention, and we are glad that the Trustees have accepted what is the feeling of scientific men generally in regard to it by appointing Dr. Harmer to the vacant post, which he is highly qualified to fill.

LORD SUDELEY is to be thanked for having brought the House of Lords to such a high appreciation of museums as educational instruments that, on March 12, in the face of some Government objections, it wholeheartedly agreed to his motion:—"That his Majesty's Government should, without further delay, reinstate the system of providing official guide-lecturers for the museums and picture galleries under the control of the Government, which, with one exception, has been in abeyance during the war, making such addition to the numbers and in the salaries and status of the guides as may be found necessary." The Government, it seems, is prepared to reinstate the pre-war conditions, but is not prepared to increase the numbers or salaries of the guide-lecturers; neither does it act with promptness in clearing the museums of alien departments. There can be no doubt as to the popular feeling in this matter, and when, twice within a fortnight, it is supported in the Upper Chamber by men of such weight as Lords Crewe, Harcourt, Meath, Morris, Gainford, and Rathcreedan, then a Government which contains many sympathetic elements should surely be emboldened to spend the relatively minute sum needed to set all this valuable educational machinery in motion. His Grace the Archbishop of Canterbury urged that an increased number of guides would permit the extension of co-operation between the British Museum and the primary schools through lectures to the teachers, who would then take their classes to the museum; there could also then be an extension of similar aid to schools of art and secondary schools. Incidentally, the Primate took occasion to extol the merits of the British Museum guide-books, from which, he rightly said, visitors might derive much advantage. Can he be aware that the General Guide to the Natural History Museum has been out of print for some years, and that a sale of many thousands to the visiting troops and others has thus been lost? A new edition of this guide should be an early claim on the time of the new director.

THE question of long-distance wireless telegraph communication is now engaging the attention of a Committee recently appointed by the War Cabinet, with Lord Milner as chairman. The need for action

has long been felt, and the recent traffic delays in cable messages have accentuated the position. It is scarcely likely that the construction of stations will proceed on the lines decided upon some time before the outbreak of the war. For one thing, the developments which are said to have been made in long-distance wireless communications during the past four and a half years will bring about a modification of the engineering features of the original scheme, while the changed political situation will doubtless lead to some alteration in the location of stations. It is also a decided gain that some attempt at co-ordination is now being made in this country. Hitherto, while no fewer than five home Departments have been directly concerned in the matter, the Post Office has been the only Department to act for the State. The result has been long-drawn-out correspondence with other offices, very commonly culminating in nothing being done. Under the new plan each of the Government Departments concerned will be represented on the recently appointed Telegraph Communication Board. Thus the individual delegates, meeting round a table, will be able to thresh things out comparatively quickly and in a far more satisfactory manner than hitherto.

ONE result of the war is that the military objections to the construction of a tunnel between this country and France have been overcome, and the work may be sanctioned within a short time. In 1875 the Channel Tunnel Co. obtained powers for preliminary works at St. Margaret's Bay, Dover, and at the same time the French Submarine Railway Co. made surveys and started a heading at Sangatte. But in 1883 a Joint Select Committee of the two Houses of Parliament decided that it was inexpedient that sanction should be given for the construction of a tunnel. Investigations have, however, continued, the promoters believing that opposition would in time be overcome. The chalk cliffs on the two sides of the Channel are similar in all respects, and rest on a stratum of grey chalk 200 ft. thick, which is impervious to water. This overlies Gault, also impervious. The tunnel is to be constructed in the grey chalk, except that at one end it may possibly enter the Gault. The excavation is easy, and no exceptional engineering difficulties are anticipated. Two parallel tunnels, 20 ft. in diameter, will be constructed for up and down traffic. One or both ends will be carried some distance inland. The total length will be thirty-three miles, about twenty-four being under the sea. It is estimated that the tunnel can be completed in six or seven years at a total cost of 20,000,000*l.* Electric traction will be adopted, which diminishes the difficulty of ventilation, and the transit will occupy about forty minutes. A small difference in the track gauge here and in France presents no difficulty. But the French loading gauge is wider than ours, so that some trains could not pass over our lines unless an alteration is made on our side. The variety of loading gauges on different lines in this country is very objectionable.

OUR contemporary the *Chemist and Druggist* for March 8 is dissatisfied with the attempt made in our article on "The Profession of Chemistry" (February 27) to differentiate chemist and pharmacist. Exception is taken to "the desire to monopolise for professional chemists the title which, first of all, indicates the seller of poisons and dispenser of medicines. It is as unreasonable to claim the monopoly of the word 'chemist' for a small class of persons as it would be to restrict the title 'engineer' to those who build a bridge or the word 'doctor' to those men who hold a medical degree." Unreasonable or not, it has to be done, sooner or later, in the interest of the public, not of "a small class of persons." English is a strange language; the meanings of words are often curiously varied in course of time and whilst rich in many ways, in others it is remarkably deficient. Etymologically, "apothecary" is the keeper of a shop, a "pharmacist" or "pharmaceutist" one who has to do with medicines; the meaning of "druggist" is clear to everyone; "chemist" has no original meaning. Having the choice of three terms with definite, well-understood connotations, the sellers of drugs and poisons may surely be satisfied; they may well agree to relinquish the vague fourth term to those who are chemists in fact. "Doctor" is the equivalent of "Dozent" and well known to be a courtesy title like "esquire," no more descriptive as applied to medical practitioners, though a volume might be written on its history and the strange and careless way in which a specialised meaning has been attached to it, whilst "esquire" has lost its original value. The medical man, it may be said, who is neither a physician nor a surgeon is even worse off than the chemist, having no name which is distinctive of his status.

THE lively discussion which was waged over the Foxhall human mandible in the sixties of last century is likely to be again revived by the advertisement inserted by Mr. Reid Moir in the personal column of the *Times* and in last week's NATURE. Mr. Moir, as is well known, has discovered and described many worked flints in the detritus bed which underlies the Red Crag of Suffolk, but no particle of man's body has yet been found at the same geological horizon with the exception of the Foxhall jaw, which, it is alleged, was derived from the detritus or coprolite bed. The mandible was in the possession of Dr. R. H. Collyer, who described it in the *Anthropological Review* of 1867; Dr. Collyer is said later to have gone to the United States, and with him the disputed specimen disappeared. It will be interesting to see if Mr. Moir's advertisement will succeed in recovering the missing mandible. Dr. Collyer's figure shows very plainly that the mandible belonged to a man of the modern type, and is remarkably similar in form to the equally hotly contested Moulin Quignon specimen found by Boucher de Perthes in the earlier Palæolithic strata near Abbeville in 1863. When Dr. Hugh Falconer and Mr. George Busk subjected the Moulin Quignon jaw to certain tests, they also applied them at the same time to the Foxhall specimen, and came to the conclusion, because of the amount of organic matter contained in them, that neither specimen could be regarded as contemporary with the strata in which it was alleged to have been found. The criteria which they applied, however, cannot be regarded as definitely deciding the authenticity of these two human "documents."

THE opposition raised both inside and outside the House of Commons, by members of the medical profession particularly, against the proposal in the Ministry of Health Bill to reconstitute the Medical Research Committee under the direction of a Committee of the Privy Council rather than under the Health Ministry was apparently not without its effect. Dr. Addison has, indeed, now issued a memorandum on the subject, setting out the advantages likely to follow the adoption of the proposed scheme, and the disadvantages which would result from its rejection. The claims made on behalf of the scheme of reconstruction are briefly that, in the realm of medical research, there will be obtained complete concentration in a central body acting for the United Kingdom as a whole, and not only for England and Wales, the area in which the new Ministry will operate; also that, in respect of all medical research questions, a

wider exchange of knowledge will be secured, for the reason that the Privy Council is the only body having an Imperial range. Finally, under such a scheme, the Committee would be freed from undue pressure by the immediate interests of any one Department, particularly the Ministry of Health. So far as the latter is concerned, the memorandum hastens to point out that there must be very special links as between it and the Committee, and arrangements to secure these would have to be made. Another point to which prominence is given is that, even with a Research Committee and special researchers, there need be no limiting of the efforts of the Ministry in the matter of scientific investigations, and at any time researches could and would be made through the staff of the Ministry. The memorandum, which is signed by Dr. Addison, is supported by a statement by Sir W. M. Fletcher, the secretary to the Research Committee, in favour of centralisation, for the reason chiefly that researches carried out on behalf of one Department so frequently yield accessory results of value to others. There was a considerable amount of discussion upon the subject when the Bill came before the Standing Committee on March 13, and Major Astor was obliged to accept an amendment making it clear that, in addition to an independent Medical Research Committee under the Privy Council, there would be a definite research department under the new Ministry. Probably this is the best way out of the difficulty, and both parties may be content to accept the compromise. The Standing Committee of the House of Commons adopted on March 18 an amendment providing that all the powers and duties of the Board of Education with respect to the medical inspection and treatment of children and young persons should be transferred to the Ministry of Health.

THE death is announced, at seventy-five years of age, of Col. F. P. Washington, R.E., for many years connected with the Ordnance Survey, and from 1898 to 1908 a director of the Survey and Map Department of the Land Registry.

A WIRELESS PRESS message states that the German Government has decided to return to China the astronomical instruments which were transported from Pekin to Germany in 1900. Negotiations have been opened for the shipping of the instruments to China.

THE annual general meeting of the Chemical Society will be held at Burlington House on Thursday, March 27, at 4 o'clock, when the retiring president, Sir William J. Pope, will deliver his address, and a ballot for the election of the new council will take place. The anniversary dinner of the society will be held the same evening at the Connaught Rooms, Great Queen Street, W.C.2.

DR. L. A. BAUER left Washington early in March for England, where he will organise an expedition, of which Mr. Frederick Brown, of London, will be a member, for magnetic and electric observations during the solar eclipse of May 29 next at a station in South Africa. Dr. Bauer expects next to proceed to South America and arrange for similar observations during the eclipse there. While in South America he will visit various institutions, and return to Washington next July.

THE death is announced, in his seventy-third year, of Mr. Louis E. Levy, of Philadelphia, who took out in 1875 the first patent granted to an American citizen in the field of photo-chemical engraving. Mr. Levy received medals from the Franklin Institute for his invention of the "Levy line screen," the "Levy acid blast," and the etch-powdering machine. His discoveries were also recognised by the expositions at Chicago in 1893, Paris in 1900, and St. Louis in 1904. Mr. Levy had been president of the Graphic Arts Co., of Philadelphia, since 1908.

THE deaths of the following engineers are recorded in the *Engineer* for March 14:—Alderman Thomas Canning, associate member of the Institution of Civil Engineers, who was appointed engineer and manager of the Newport Gas Co. in 1874, and held office up to the time of his death; Mr. R. W. A. Southern, member of the Institution of Mining Engineers, a mining engineer well known in South Wales as a colliery manager, and in private practice; and Mr. G. H. Hill, member of the Institution of Civil Engineers, and largely responsible for the water supply of Manchester, especially in connection with the Thirlmere scheme.

THE Salters' Institute of Industrial Chemistry has awarded fellowships for post-graduate study in the universities or colleges indicated to Messrs. W. H. Gough and W. A. Haward (Imperial College of Science and Technology), Capt. L. J. Hudleston (Reading), Lieut. K. H. Saunders and Mr. Gordon M. Wright (Cambridge), Mr. P. N. Williams (Liverpool), and Mr. Dudley C. Vining (Finsbury Technical College). Through the generosity of certain leading firms, the institute hopes shortly to announce further appointments; those who have already provided funds for assisting the purpose of the institute are Messrs. Borax Consolidated, the Mond Nickel Co., and Lever Brothers.

THE council of the Royal Institute of Public Health is arranging for a conference in the Guildhall, London, on "Problems of Reconstruction in Relation to Public Health" on June 25–28. The opening meeting will be held in the Egyptian Hall of the Mansion House on Wednesday, June 25, when the Lord Mayor of London will preside. The conference will be devoted to the work of the Ministry of Health, the prevention and arrest of venereal disease, housing in relation to national health, maternity and child welfare, and the tuberculosis problem under after-war conditions. Full particulars may be obtained on application to the Secretary, Royal Institute of Public Health, 37 Russell Square, W.C.1.

THE *Times* of March 17 gives an account from its correspondent at Sydney of a remarkable Australian rainfall. It states that "the extraordinary rainfall at Melbourne threatens the greatest flood since 1891. The south-eastern corner of Victoria and New South Wales is almost engulfed. At Port Melbourne factories have been swamped." At the time of the report, March 7 (delayed), rain was still falling. "At Macedon 8 in. were registered in twenty-four hours, and other watersheds have been converted into lakes. Thousands of persons are homeless. Thirteen inches of rain in twenty-four hours has practically drowned the township of East Bellingen, in New South Wales. . . . Although the damages are estimated to aggregate tens of thousands of pounds, the benefits from the breaking of the drought will be represented by hundreds of thousands."

WE regret to have to record the death on February 16, from pneumonia following influenza, of Mr. R. W. H. Row, lecturer in zoology at King's College, London. Although only thirty-four years of age, Mr. Row had already done much to advance the science to which he had devoted himself, both as a teacher and as an

investigator. He had, partly in co-operation with Prof. Dendy, published several memoirs on sponges, on which he had become a recognised authority. Since 1914 Mr. Row had been responsible for the section of the Zoological Record and International Catalogue of Scientific Literature dealing with this group of animals. After the outbreak of the war he devoted himself largely to protozoology from the pathological point of view, working under Sir Ronald Ross, and at the time of his death, in addition to his ordinary duties, he was in charge of the malaria laboratory at the 4th London General Hospital. Besides the routine work of blood examination, etc., Mr. Row managed to do a good deal of original work in this branch of zoology. He left much unfinished work behind him, and the loss to zoological science occasioned by his death is great.

THE Royal Geographical Society announces that the King has been pleased to approve the award of the Royal medals as follows:—The Founder's medal to Col. E. M. Jack for his geographical work on the Western Front, and the Patron's Medal to Prof. W. M. Davis, of Harvard University, for his eminence in the development of physical geography. The Victoria medal is awarded by the council to Prof. J. W. Gregory for his many and important contributions to geographical science; the Murchison grant to Dr. W. M. Strong, of the North-Eastern District, Papua, for his journeys and surveys in New Guinea; the Cuthbert Peek grant to Prof. Rudmose Brown for his geographical work in the Antarctic and in Spitsbergen; the Back grant to the Ven. Archdeacon Stuck, of Fort Yukon, for his travels in Alaska and ascent of Mount McKinley; and the Gill memorial to Mr. W. J. Harding King for his investigations of desert conditions in northern Africa.

THE *Times* of March 13, under the heading of "Influenza Worse than Many Plagues," gives a startling statement from its Delhi correspondent based on a Government report of the influenza epidemic by Major Norman White, who has just vacated the position of Sanitary Commissioner, which he had filled with distinction. "Major White declares that from the incomplete information available it would appear that no country has suffered as severely from the disease as India during the last quarter of 1918. Without fear of exaggeration, it can be stated that influenza was responsible for six million deaths, equivalent to more than half the mortality attributable to plague in the twenty-two years during which plague has been epidemic in this country. Five million deaths occurred in British India, and one million in the native States." Major White states that the incidence of the epidemic "was very high among the well-fed British troops, higher, indeed, than among the Indian troops." In his report he says: "It can be stated without exaggeration that from 50 to 80 per cent. of the total population have recently suffered from influenza."

THE Registrar-General's return for the week ending March 8 gives the following highly satisfactory statement:—"The influenza epidemic appears now to have passed its most severe stage, the number of deaths registered in the ninety-six great towns having declined from a maximum of 3889 in the week ended March 1 to 3218 last week, and in London from 808 to 597." The general health of London has also improved, the annual death-rate per thousand of the aggregate population having further decreased from 32·4 in the preceding week to 26·6 in the week ending March 8. The deaths from influenza are, however, still very high, being more than double those in any week during the summer epidemic of 1918, and more than one-half of the total deaths in the eight weeks of that epidemic, also larger than in any week of any previous epidemic since 1890, 560 deaths in a single week during the attack in 1892 being until the present epidemic the highest on record. The epidemic which started in London during the week ending October 12, 1918, has now continued for twenty-two weeks, causing 14,344 deaths out of 45,262 total deaths from all causes; the deaths, however, fell below 100 during each of the six weeks from the end of December last year to the commencement of February this year.

ON March 5 the Natural History Museum Staff Association held in the board room of the museum, by permission of the Trustees, its inaugural scientific reunion. The object of these meetings, which it is intended at first to hold about four times a year, is twofold: in the first place, members of the staff will be afforded an opportunity of meeting one another and of seeing something of the work done in departments other than their own, and, in the second, scientific workers outside the museum, who are invited to attend, will have an opportunity of seeing some of the more interesting of the specimens which have been recently added to the collections, and also of becoming acquainted with some of the research work carried on at the museum. The number of visitors is necessarily limited, because the capacity of the board room—the only room available—is not great. Major E. E. Austen, of the Entomological Department, gave an interesting lecture on the anti-mosquito work carried out in Palestine during the campaigns of 1917 and 1918. The exhibits included the following:—A series of skulls of whales found round the British Isles, a case illustrating the depredations of marine boring animals, the Church collection of precious stones, a slice of the Skookum meteorite, specimens illustrating curvature in crystals, Carragheen moss and invalid dishes made with it, specimens showing mechanical adaptation in labroid fishes, some of the suite of butterflies in the Dollman collection, German substitute tobacco, etc.

THE British Association Fuel Economy Committee, which was originally appointed in 1915, and issued its first report in 1916, has, owing to the urgency and importance of the coal situation and fuel economy in connection with reconstruction problems, been reappointed to continue its investigations upon the various economic, scientific, and technical issues connected with the production and utilisation of coal and other fuels. Prof. W. A. Bone has been reappointed chairman, with Mr. H. James Yates as vice-chairman, and Mr. Robert L. Mond as secretary. The general committee of thirty-three members includes representatives of the Association of British Chemical Manufacturers, Coke-Oven Managers' Association, Federation of British Industries, Institution of Electrical Engineers, Institution of Gas Engineers, Institution of Mechanical Engineers, Institution of Mining and Metallurgy, Institution of Mining Engineers, Iron and Steel Institute, Society of British Gas Industries, and Society of Chemical Industry. The executive committee, which consists of Sir Robert Hadfield, Sir Joseph Walton, M.P., Profs. W. A. Bone, Henry Louis, and W. W. Watts, Dr. H. S. Hele-Shaw, Messrs. A. Hutchinson, Robert Mond, W. H. Patchell, H. Woodall, C. H. Wordingham, and H. James Yates, meets in London on the second Wednesday in each month. The Committee is now compiling data

and information concerning a number of subjects of public interest, including, *inter alia*, such questions as (1) the economic aspects of coal production in Great Britain, (2) low-temperature distillation of coal, (3) future standards for public gas supplies, and (4) the proposed electric power scheme, etc., and invites individuals, firms, or institutions who may possess information of value to place it at the disposal of the Committee. All communications should be addressed to Prof. W. A. Bone at the Imperial College of Science and Technology, South Kensington.

WE regret to record the death on February 28, in his fifty-eighth year, of Mr. F. C. Forth, principal of the Municipal Technical Institute, Belfast. Mr. Forth's death has removed from that city, and from Ireland generally, a potent force in the promotion of scientific and technical instruction and training. On the passing of the Agriculture and Technical Instruction (Ireland) Act of 1899 the Corporation of Belfast took immediate steps to inquire into the facilities for technical instruction existing in Belfast and found them totally inadequate, only five institutions existing with some seven or eight hundred students enrolled. It thereupon decided to appoint a principal and director of technical instruction and to prepare a scheme for a new building, and in 1901 Mr. Forth, then vice-principal of the School of Technology, Manchester, took up the post. An admirable site was secured, and with the aid of the new principal, whose knowledge and experience gained in Manchester proved of singular service, a splendid building, standing on upwards of 5000 square yards in one of the principal avenues of Belfast, was erected, calculated to serve the best interests of the great engineering, textile, and other industries of the city. The foundation-stone was laid in November, 1902, and the building opened by the Lord-Lieutenant in 1907; and the institute has now an enrolment of 7000 individual students. Mr. Forth was a born teacher and organiser, able to infuse his enthusiasm into both students and colleagues. In 1915 he was elected a fellow of the Royal College of Science, Ireland, "in consideration of the manner in which, through your work as an educationist in the field of technical instruction, you have contributed to the advancement of science in Ireland." At a special meeting of the Library and Technical Instruction Committee of the Belfast Corporation a resolution was passed recording its sense of the profound loss sustained by the corporation and the city generally in the death of the highly esteemed and brilliantly successful principal of the Municipal Technical Institute, Mr. F. C. Forth.

A MEETING of the Illuminating Engineering Society on February 25, when the lighting of railways was discussed, was attended by representatives of a number of the leading railways. Mr. A. Cunnington, lighting engineer to the London and South-Western Railway, who read the introductory paper, remarked that by the aid of available experience tentative standards for the lighting of platforms, goods sheds, and goods yards could now be formulated. Stations were divided into three classes, the specified illumination being 0·5, 0·25, and 0·035 foot-candle respectively, measured in a horizontal plane 3 ft. above the platform. In goods sheds, values about twice as high were suggested. A number of special installations were described, including corridors, parcels offices, and signal-boxes. In the discussion, the importance to railway companies of employing an expert in lighting to deal with all problems connected with illumination was strongly emphasised.

OUR ASTRONOMICAL COLUMN.

PHOTO-ELECTRIC DETERMINATIONS OF STELLAR MAGNITUDES OF PLANETS.—*Astr. Nach.*, No. 4976, contains a paper by P. Guthnick on the application of this very accurate method to the determination of the stellar magnitudes of Saturn and Mars. The individual results show that the probable error of a determination is in the neighbourhood of 0·01m. The results of a comparison of Saturn with Pollux are given for four oppositions; after allowing for the changing aspect of the ring they are practically constant, and show that without the ring the planet is just 1/3 mag. brighter than the star. As two of the oppositions were at sun-spot minimum and two at maximum, the inference is also drawn that there is no sensible variation of sunlight in the course of the cycle. Very numerous comparisons of Mars with standard stars were made; the results are grouped according to longitude of central meridian, and show that the planet is variable to the extent of 1/6 mag., according to the portion presented to us. The light-curve obtained is consistent for the same opposition, but varies from one opposition to another with the different pose of the planet's equator and the amount of snow or cloud that is present on the disc.

NOVA AQUILÆ.—The Monthly Notices of the Royal Astronomical Society for December last contains papers on this nova's spectrum by the Rev. A. L. Cortie and Dr. J. Lunt. The former reproduces six spectra photographed in June and July, which illustrate the development of the hydrogen bands. Both papers give wave-length tables and identifications; lines due to iron, titanium, chromium, scandium, barium, helium, calcium, etc., are identified. Both also note that the line-of-sight velocities fall into two groups, one of the order of −1500 km./sec., the other of the order of −800 km./sec.

The same issue of the Monthly Notices contains a paper by Dr. A. A. Rambaut on the visual magnitudes of the nova from June 9 to December 10; the table shows a well-marked periodic variation with a period of eleven days during July and August; after correcting for the progressive decline, the range from maximum to minimum was just half a magnitude.

THE VARIABLES OF LONG PERIOD.—Many astronomers have of late inclined to the theory that the red variable stars, of types M and N, are dwarf stars, near the end of their career as suns, on which an incipient crust is forming. Mr. W. Gyllenberg, of the Lund Observatory (*Arkiv för Matematik, Astronomi och Fysik*, K. Svenska Vetenskapsakademien, Band 14, No. 5), examines the question of their distances by means of their proper motions. Contrary to the above dwarf theory, he finds that the stars are very distant, and must be classed as giants, their mean absolute magnitude at maximum (at a distance of 10 parsecs) being −0·65, making them comparable in absolute lustre with stars of the types B8 to A2. The mean velocity in all directions comes out as 37·7 km./sec., in admirable accord with the value 36·4 found by Mr. Paul W. Merrill (*Astrophysical Journ.*, xli., 247) from motions in the line of sight.

Adopting the above mean absolute magnitude, and plotting the distances of the stars from their brightness, they show greater extension in the galactic plane than perpendicular to it, which confirms the conclusion that they are distant. The denser parts of the system extend to 3000 L.Y. in the plane, 1000 L.Y. perpendicular to it. The distances found for the M variables accord well with those previously found for non-variable giant stars of type M. It thus appears that long-period variability is an incident in the early history of star-life.

REPORTS OF THE AUSTRALIAN ANTARCTIC EXPEDITION.

The scientific results of the Australian Antarctic Expedition are being published with commendable promptitude. Of the five parts recently received the most generally interesting is the report on the Brachiopoda by Dr. J. Allan Thomson, Wellington, N.Z. The Brachiopods recorded, though not many in number, are relatively rich in species, a new genus, Amphithyris (family Terebratellidæ), and new species of seven other genera being described. The author gives a summary of the known distribution of Brachiopods in South Temperate and Antarctic seas, and discusses the bearing of the facts on the theories of southern land connections, "which it is one of the aims of Antarctic expeditions to prove or disprove." He points out that the known larvæ of Brachiopods, with the exception of those of Lingula and Discina (*sensu lato*), have no mouth during the free-swimming stage, and that they soon settle down. Consequently, the deep oceans are barriers which Brachiopods, the majority of which live on the submarine slopes of continents and adjacent islands, and their larvæ cannot cross, and therefore cases of discontinuous distribution of these shallow-water forms have an important significance.

Dr. Thomson considers there is abundant evidence, from the associated molluscan fauna, that the Patagonian (Miocene) of South America and the Oamaruian (older Tertiary) of New Zealand had a much warmer climate than the present, and that the occurrence of the same Brachiopod genera and species in the Oligocene-Miocene of the Antarctic strongly suggests that at this period the Antarctic seas were also warmer. Mr. Tate Regan, in his report on the *Terra Nova* fishes, inclined to the view that the coasts of Antarctica were washed by cold seas probably throughout the Tertiary period, but in Dr. Thomson's view the geological evidence all points the other way.

From a consideration of the distribution of the Brachiopods he arrives at the following conclusions: Connections—not necessarily land-bridges, but chains of islands or shallow submarine ridges—must have existed between Australia and South Africa at some date prior to the Tertiary, by which the primitive genera of the Terebratellidæ attained their present distribution in South Africa, St. Paul's and Marion Islands, Australia, and New Zealand. The specific and generic distinctness of the recent New Zealand and Australian forms precludes any land connections between these areas in Pliocene or later times. The two groups of Terebratellidæ concerned would seem to have originated on the coasts of Gondwana Land, on the remnants of which they now survive; the Kerguelen area apparently did not share in the connection with Gondwana Land. Connections between Australia, New Zealand, the Macquarie Islands, Kerguelen, Antarctica, and South America must have occurred in the early Tertiary, but New Zealand was not connected at the same time with Australia and Antarctica. The connections between New Zealand, Antarctica, and South America may have existed from an earlier period. It does not appear probable that Australia was connected directly with Kerguelen and Antarctica during the Cretaceous or early Tertiary. The southern connections were broken, much as at present, by Miocene times, and since that period there have been no renewed connections between the southern continents and island areas except, possibly, between South America, Antarctica, and the adjacent islands.

Dr. W. G. Ridewood records (vol. iii., part 2), from off Adelie Land and Queen Mary Land, four species of Cephalodiscus—*hodgsoni, nigrescens, solidus*, and *densus*—and gives details of the external features of the colonies and notes on the colour and structure of the zooids. For further details of these species reference may be made to Dr. Ridewood's recent report on the specimens of Cephalodiscus collected by the British Antarctic (*Terra Nova*) Expedition, a notice of which will appear in another issue of Nature.

A brief account of the Euphausiacea and Mysidacea is given by Dr. W. M. Tattersall (vol. v., part 5), and of the Cumacea and Phyllocarida by Dr. W. T. Calman (part 6).

Prof. A. Dendy (vol. vi., part 1) reports on the calcareous sponges. The Antarctic forms comprise two new species of Leucetta, a new species of Leucandra, and a new variety of Grantia. In the account of the monaxon spicules of a variety of *Leucosolenia botryoides* from Macquarie Island, Prof. Dendy takes the opportunity of correcting an error in the late Prof. Minchin's well-known memoir on the British species of this genus. Minchin considered that the monaxons of Leucosolenia were separable into two kinds, one very refringent, the other much less so, the refringent monaxons being fewer, straighter, more slender, and having the distal barb less distinct or absent. Prof. Dendy points out that the explanation of these differences is simply that some of the monaxons were viewed as they lay on edge, while others were seen lying flat.

NEW PROCEDURE AT AMERICAN MAGNETIC OBSERVATORIES.

In accordance with the usual practice of the United States Coast and Geodetic Survey, two years, 1915 and 1916, are dealt with in the *Results of Observations* at the magnetic observatories at Sitka and Honolulu, which have recently been published. In previous years the curves were read unsmoothed exactly at the hour local mean time. Commencing with 1915, the hourly value represents the mean ordinate for sixty minutes ending with the hour of the 135th meridian at Sitka (135° 20·1′ W.), and of the 165th meridian at Honolulu (158° 3·8′ W.). The value entered, for instance, under 2h. really belongs to 1·5h. Diurnal inequalities continue to be given, as in the past, only for 10q (quiet) days a month chosen locally, and for the 5q (international quiet) days, but hourly means are given for all days. The adoption of mean ordinates instead of instantaneous readings is in accordance with what is now probably the usual practice. Unless it is followed, all-day diurnal inequalities for disturbed months are apt to be very ragged. But the adoption of means for sixty minutes ending at the hour, instead of sixty minutes centring at the hour, is a practice not generally followed except in Germany. Even if the procedure had distinct advantages over the ordinary one, its spasmodic adoption by individual observatories or in individual countries has the serious drawback of introducing diversity where uniformity is desirable. This is especially true of the international quiet days, the special object of which is to supply exactly corresponding data from different observatories.

The advantage claimed for the new procedure is that it makes the day self-contained, whereas with the ordinary procedure the values for the first and last midnights depend, one on the last half-hour of the previous day, the other on the first half-hour of the following day. This argument has much weight in the case of elements like rainfall or duration of sunshine, where we deal with aggregates. But in the case of magnetism the procedure does not really make

the day self-contained unless we neglect the n.c. (non-cyclic) changes, which are seldom really negligible. These changes should, in any case, be explicitly shown, as they are generally in part of instrumental origin. The only reference to them at Honolulu seems to be a statement that they have been allowed for in the case of the 5q-day inequalities. At Sitka there is the further statement that, so far as possible, days with large n.c. changes have not been chosen for the 10q days. It would be interesting to know how the n.c. corrections were found for the 5q days, and whether they were entirely omitted for the 10q days.

An idea of the size of the n.c. changes on quiet days can usually be derived from the size of the difference between the mean daily values for these days and for all days. From the twenty-four monthly means of 1915 and 1916 given for all days and for the 10q days, we find for the mean algebraic excess of the latter class over the former $+6{\cdot}0\gamma$ in H (horizontal force) and $+5{\cdot}4\gamma$ in V (vertical force) at Sitka, and $+7{\cdot}5\gamma$ in H and $-1{\cdot}1\gamma$ in V at Honolulu. In D (declination) the mean difference between the two sets of mean values is only about $0{\cdot}05'$ at both stations. The 5q days give very nearly the same mean daily values as the 10q days. We should naturally infer that while the n.c. change may be negligible in D, it is probably by no means negligible in H at either station, or in V at Sitka. Confirmatory evidence is derivable from the highly disturbed days, the characteristics of which are usually the direct opposite of those of quiet days. If we take as representing disturbance the five days of largest daily range in each month, we find that on the average the monthly mean values derived from these days fall short of the corresponding all-day means by $14{\cdot}4\gamma$ in H and $15{\cdot}3\gamma$ in V at Sitka, and by $9{\cdot}1\gamma$ in H and $2{\cdot}3\gamma$ in V at Honolulu. Disturbance in V is unusually large at Sitka, and exceptionally small at Honolulu, which, presumably, explains the large difference between the mean values from the 5q and 5d days at the former station, and the small difference at the latter station. If a diurnal inequality were to be derived from the 5d days, as has recently been suggested, the n.c. element would almost certainly be of great importance at Sitka in H and V.

Another feature wanting explanation is that the 5q days are shown in the tables as days of 165° W. at Honolulu, and as days of 135° W. at Sitka, whereas they are really 24-hour periods commencing at Greenwich midnight. It is to be hoped that this is only camouflage, just as when values belonging really to 1·5h. are entered under the heading 2h., because considerable disturbance is occasionally experienced within less than nine hours of the end of true international quiet days. Explanation on this point, on the n.c. changes, and on the effect on the ranges of the diurnal inequalities consequent on the change of procedure would be welcome in the next issue of these valuable publications.

C. CHREE.

FOREST RESEARCH IN EUROPE.

A USEFUL account of forest research in Europe by Mr. S. Howard has appeared in the *Indian Forester* for September last. "Forest research, in many instances, necessitates observations over long periods of time, longer than an individual man's working years, and over widely separated areas. Some institution is necessary, therefore, to direct methods for the sake of uniformity, and to continue ideas, despite the necessary changes in the research *personnel.*" Germany was the first country to organise research, this movement dating from 1868, when it was proposed at a meeting of prominent foresters at Regensburg that the larger States, Austria, Prussia, and Bavaria, should have independent research institutes. It was finally decided in 1870 that forest research should be properly organised, and that the research institutes in all the States were to be combined with the educational branch—that is to say, the president of the forest college was also to be president of the research institute. In 1912 all German States of importance had their forestry institutes (in each case combined with the college of forestry) united under the German Forest Research Association, which meets, as a rule, twice a year. The Prussian Research Institute, united with the Forestry College at Eberswalde, has six branches, dealing with sylviculture, physical chemistry, meteorology, plant physiology, zoology, and mycology.

Besides the headquarters at Eberswalde, there are numerous experimental plots of trees all over Prussia. These were at first put under the local forest officer, but this proved a failure; and for more than twenty years all work connected with the plots has been done by the research staff at Eberswalde. The sylvicultural branch compiles yield tables and statistics, and has carried out investigations on exotic trees, root-formation, manures, technical properties of wood, seed tests, etc. It is to be noted that the tests of strengths of wood and the like are done by technical experts at Charlottenburg, and not by the Forest Research Institute. The meteorology branch is especially concerned with experiments on the influence of forests on climate. The plant physiology branch is purely botanical, and takes up subjects like the formation of annual rings, the influence of locality on seeds, the influence of soil factors on trees, etc. The zoology branch is concerned with zoological researches, so far as they concern forests, and with control methods; the physical chemistry branch with the chemistry of soils, the formation of humus, the formation of pan, etc.; and the mycology branch with mycology in its relation to forestry and control methods.

Forest research was organised in France in 1882, but was hopelessly carried out. Experiments were begun, but were usually badly organised and badly performed, and ceased absolutely between 1896 and 1902. The research work proposed in France was to cost 1200*l.* per annum. Germany has actually been spending 6000*l.*, Switzerland 2000*l.*, and Sweden, roughly, 880*l.* a year.

Mr. Howard gives also an account of the International Forest Research Association, which met at Mariabrunn in 1893 and 1903, at Brunswick in 1896, at Zurich in 1900, and at Brussels in 1910. Most European countries are members, but France is not, or, if she is, has taken no active part. The usefulness of these international meetings was undoubted. For example, it was soon found essential to have some classification of thinnings, if results were to be comparable. The Prussian classification was adopted in 1903.

THE CONSERVATION OF OUR CEREAL RESERVES.[1]

THE dangers to which grain stored under ordinary conditions is exposed may be classified under four heads:—(1) The attacks of rats and mice, (2) those of insects and mites, (3) those of moulds and bacteria, and (4) the process known as "heating." The amount of damage due to rats and mice is, no doubt, enormous, but might be avoided by any rational system of storage, and is a matter

[1] Abstract of a lecture delivered at King's College, London, on March 12, under the auspices of the Imperial Studies Committee of the University London, by Prof. Arthur Dendy, F.R.S.

for legislation rather than for scientific investigation. The chief insect pests in this country are the two grain-weevils, *Calandra granaria* and *C. oryzae,* while in India two other beetles, *Rhizopertha dominica* and *Trogoderma khapra,* are also responsible for much direct injury. Experiments on the rate of multiplication of the weevils show that at suitable temperatures they breed all the year round, but in this country normally only in the warmer months. At about 28° C. a single pair of rice-weevils increased about seven-hundred-fold in four months. The accumulated excrement of the weevils attracts moisture and promotes decomposition, accompanied by the evolution of large quantities of ammonia, and in this way the destruction commenced by the ravages of the insects is completed. The process of heating is the result of enzymic action in the wheat itself, sometimes inaccurately spoken of as respiration, though fermentation would be a better term, which increases with rise of temperature (up to about 55° C.) and moisture content (Bailey and Gurjar). In the eyes of the trade, heating appears to be a much more serious danger than weevilling. It is at present avoided by abundant ventilation, the grain being turned over as soon as the temperature becomes dangerously high, so as to cool it and carry off moisture.

As an effectual means of preventing damage from all these sources, airtight storage should be resorted to. Unfortunately, however, considerable doubt has been thrown on the efficacy of this ancient method by a widespread belief in the ability of weevils to withstand such treatment. This belief rests entirely upon inaccurate observations. Thus we find that tins which are supposed to be hermetically sealed, and look perfectly sound, are often leaky, as can easily be shown by placing them in hot water, when air bubbles out. Numerous experiments made at King's College by the lecturer and his colleague, Mr. H. D. Elkington, who is responsible more especially for the chemical analyses, prove conclusively that all insects present are more or less rapidly destroyed when weevilly wheat is sealed up in airtight receptacles which it nearly fills. This method of treatment destroys the weevils in all their stages, and is also fatal at any rate to adult mites. The same treatment also prevents the growth of moulds and the process of heating. Two Dewar flasks, filled with grain having a moisture content of 20·7 per cent., were incubated at about 28° C. One was merely plugged with cotton-wool and the other hermetically sealed. In the former the temperature gradually rose to 49·4° C., while in the latter it remained almost stationary. The life of insects and moulds and the process of heating alike depend upon the supply of oxygen, and where this is cut off no damage from these sources need be feared.

It has been demonstrated experimentally, not only that weevils require an abundant supply of oxygen, but also that carbon dioxide, if present in sufficient quantity, has a directly poisonous action upon them. In pure, moist carbon dioxide they become motionless in three minutes, and can remain in this condition for as much as four days (at room temperature) without losing the power of recovery. A mixture of carbon dioxide with 20 per cent. of oxygen is far more fatal than pure carbon dioxide. This is probably because, in the absence of oxygen, their metabolism is more or less completely suspended, so that the carbon dioxide is unable to exercise its poisonous effect. In a mixture of 56·4 per cent. nitrogen, 20·36 per cent. oxygen, and 23·22 per cent. carbon dioxide weevils became motionless in forty-three hours (at about 30° C.), and after ninety-one hours' exposure, though 19·09 per cent. of oxygen still remained, none revived when supplied with ordinary air.

When wheat is sealed up in a normal atmosphere carbon dioxide accumulates naturally owing to the so-called respiration of the grain, the rate of accumulation depending upon temperature and moisture conditions. At ordinary room temperature (July to October) in three months 300 grams of English wheat, having a natural moisture-content of 15·9 per cent., gave off 58·6 milligrams of carbon dioxide, sufficient to raise the percentage of that gas in the air in the receptacle (which was nearly filled with wheat) to 18·13. If insects also be present, the carbon dioxide accumulates more rapidly owing to the large amount which they themselves give off. It thus appears that in hermetically sealed granaries completely filled with grain there should be no need for any artificial addition of carbon dioxide such as has sometimes been recommended, and, indeed, actually made, for the purpose of destroying weevils. Under proper conditions, which ought to be experimentally determined on a large scale, the grain must become self-protective as regards weevilling, mildew, and heating, to say nothing of rats and mice. Any damage which might arise while the carbon dioxide was accumulating would probably be negligible.

The construction of airtight granaries or silos is a problem for the engineer, but there seems to be no insuperable difficulty in the way. If such granaries existed in the large wheat-growing countries the grain might be completely sterilised as regards insect-life by storing for a suitable period before shipment, and the very serious weevilling which often takes place on board ship might be avoided. Moreover, it would be possible to equalise shipments all the year round and avoid the rush to get the grain away after harvest. Airtight storage would also, in all probability, afford by far the best means of maintaining reserves of grain to meet emergencies such as war and failure of crops.

Further details have been, and will be, published in the reports of the Grain Pests (War) Committee of the Royal Society, under the auspices of which these investigations have been carried out.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Joseph Barcroft, F.R.S., of King's College, has been appointed reader in physiology; Mr. A. V. Hill, F.R.S., of King's College, University lecturer in physiology; and Dr. Hartridge, of King's College, University lecturer in the physiology of the senses.

The adjudicators for the Adams prize have proposed as the subject for the prize for the period 1919–20 "The Nature and Analysis of Optical Spectra."

LIVERPOOL.—The council of the University has accepted with great regret Prof. Herdman's resignation as from September 30 next of the Derby chair of natural history, which he has held since 1882. As announced in NATURE of February 27, Prof. Herdman will occupy the new chair of oceanography, without salary, for a period of one year from October 1 next, and this tenure will perhaps lessen the severity of the wrench he must feel at severing his long professorial connection with the University. He will be greatly missed by the University staff and students, but freedom from lectures and administrative duties will give him much more time for research, to which he proposes to devote his remaining working years.

Throughout his long period of service in the University Prof. Herdman's interest in marine biology and oceanography has made the department a very notable one, and established a tradition for it which scientific men will hope to see maintained. In 1885 he brought together the local biologists and started the Liverpool Marine Biology Committee, and a year later the Liverpool Biological Society. The committee established itself in its first biological station at Puffin Island, in Anglesey, and five years later at Port Erin, in the Isle of Man, in a laboratory which has grown continuously since its foundation, and has now become very well known. In 1892 Prof. Herdman became honorary scientific adviser to the Lancashire Sea Fishery Committee, which established the present fisheries laboratory at the then University College, and some years later the Biological Station and Hatchery at Piel, in Barrow. As the result of all these activities the general and fishery biology of the sea off Lancashire, Wales, and the Isle of Man has now become better known than any other similar area off these islands. Two years ago Prof. and Mrs. Herdman endowed a chair of geology at Liverpool in memory of their son George, who was killed in the war, and the chair of oceanography recently established by them will be a most suitable means of maintaining and extending those investigations which Prof. Herdman began and has done so much to stimulate and promote.

AT the recent commemoration day exercises of the Johns Hopkins University, it was announced, says *Science*, that a sum of approximately 80,000*l.* had been given anonymously for the erection of a building to serve as a woman's clinic at the Johns Hopkins Hospital.

THE committee appointed by the British Association comprised of Mr. C. A. Buckmaster (chairman), Mr. D. Berridge (secretary), Mr. C. H. Bothamley, Dr. Lilian J. Clarke, Prof. Barbara Foxley, Dr. W. Garnett, Prof. R. A. Gregory, Prof. H. B. Smith, Dr. H. L. Snape, and Miss C. M. Waters, to consider the policy and results of the "free place system" in secondary schools in England and Wales, under which largely increased grants are given to such schools conditional upon their admitting 25 per cent. of pupils from elementary schools or such lower percentage approved by the Board of Education, has issued an instructive and suggestive report after exhaustive inquiry into the working of the system in various classes of schools, both urban and county. The results of the committee's investigations go to show that the system is on the whole bearing satisfactory fruit, enabling a considerable number of children attending public elementary schools, who in ordinary circumstances would cease their education at or below fourteen years of age, to continue it to their great advantage up to and beyond sixteen, and in some cases to pass into the universities. The committee makes certain specific recommendations for the improvement of the system, such as: free places should not be awarded to children above twelve years of age; the necessity for a good mid-day meal is enforced; in many cases maintenance grants should also be given; greater facilities should be offered for the effective support of secondary-school children of exceptional ability to enter the universities and technical high schools; power should be given for the removal of children from the free place list who are reported for habitual laziness; the award of free places should depend upon an oral as well as upon a written examination; and finally, the free place system should be made available for all classes of the community, say, under the condition that the candidates must have been educated for two years in a school classed by the Board of Education as "efficient." The report is accompanied by interesting tabular statements illustrating the results of the inquiries made.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 6.—Sir J. J. Thomson, president, in the chair.—L. F. **Richardson**: (1) Atmospheric stirring measured by precipitation. The equation for diffusion is investigated in the general case in which atmospheric density and degree of turbulence must both be regarded as varying with height, and it is found that the stirring is best measured by the coefficient ξ in the equation

$$\frac{\delta\mu}{\delta t}=\frac{\delta}{\delta p}\left(\xi\frac{\delta\mu}{\delta p}\right), \text{ in preference to } \kappa \text{ in } \frac{\delta\mu}{\delta t}=\kappa\frac{\delta^2\mu}{\delta h^2}.$$

Here p is pressure, h height, and μ either entropy per unit mass, or mass of water per unit mass, or horizontal momentum per unit mass in a fixed azimuth. In place of entropy per mass we may, with advantage, take potential temperature. From estimates of precipitation and vertical gradient of water per mass of atmosphere, as means over the whole globe, it is found that ξ has the following mean values:—

Height		ξ
8500 metres	...	3 to 180 cm.$^{-2}$ grm.^{2} sec.$^{-5}$
500 „	...	140,000 „ „
0·5 „	...	possibly as low as 1000 or even less.

The value at 500 metres is in fair agreement with ξ as deduced from κ, calculated by Akerblom, by Hesselberg, and by Taylor, for heights of a few hundred metres. The values of ξ at other levels are remarkably smaller. (2) Measurement of water in clouds. Photometric methods enable an estimate to be made of the amount of water in clouds in terms of the diameter of the cloud droplets. For thin cloud, through which the sun can be seen, it is the contrast of brightness between the sky and the sun which is measured. For thick, uniform stratus it is the total light transmitted to earth which is measured as a fraction of the incident sunlight. If the cloud were compressed into a homogeneous horizontal lamina, of water or of ice according to its temperature, the thickness of this lamina would appear to have the following values when expressed as a multiple of the diameter of the cloud droplets:—For cirrus, cirro-stratus, and cirro-cumulus, on the average about 0·5; for stratus which only just permitted the sun to be seen, 4·1, the sun's zenith distance being 49°; for a strato-nimbus of ordinary appearance, 24.

Aristotelian Society, March 3.—Prof. Wildon Carr in the chair.—Mrs. N. A. **Duddington**: Our knowledge of other minds. On the basis of a realistic theory of knowledge, our knowledge of other minds must be pronounced to be as direct and immediate as our knowledge of physical things. Mental states "lived through" by one person may be discerned or discriminated by another. Thus if we see someone weep we become aware of his grief simultaneously with his sobs, dejected attitude, etc.; the grief is revealed to our contemplation in precisely the same sense as the bodily changes are. We may sometimes infer people's emotions from their bodily attitude, but if there were no direct acquaintance with other mental lives we should have no clue for the interpretation of their expressive behaviour, and it would

have no meaning for us. The existence of other selves cannot be inferred, as is usually supposed, from the analogy which their behaviour presents to our own, because (1) no priority attaches to the awareness of our own selfhood; (2) the alleged inference would have to be made for the first time at an impossibly early age; (3) the behaviour of others presents, from the point of view of the percipient, no analogy to his own; and (4) if other selves were merely inferred entities, human affections and relationships could not be what they are. It is consistent with any theory of the ultimate nature of mind to maintain that the presence of other selves and the affective aspect of them can be directly apprehended.

Mathematical Society, March 13.—Mr. J. E. Campbell, president, in the chair.—J. **Hammond**: The solution of the quintic.—L. J. **Mordell**: A simple algebraic summation of Gauss's sums.—Major P. A. **MacMahon**: Divisors of numbers and their continuations in the theory of partitions.—S. **Ramanujan**: (1) Congruence properties of partitions. (2) Algebraic relations between certain infinite products.

Linnean Society, March 20.—Sir David Prain, president, in the chair.—Dr. Harold **Wager**: The colour-sense of wasps. The experiments described in this paper were made by observing the number of wasps flying towards, and settling upon, pieces of sugar placed upon sheets of coloured paper arranged in various ways. The results show that in seeking their food wasps (*Vespa vulgaris*) are guided by their social instinct, their remembrance of locality, and their power to distinguish conspicuous colours or colour-contrasts. They are probably also guided by smell, but no experiments were made to test this. Leaving out of account the probability that smell plays an important part in their activities, the experiments indicate that the governing principles which dominate wasps in their search for food are, first, the attraction exerted by the presence of other wasps; secondly, the tendency always to return to the same place; and, thirdly, the attraction due to conspicuous colours and colour-contrasts.

Cambridge.

Philosophical Society, February 17.—Mr. C. T. R. Wilson, president, in the chair.—Dr. **Doncaster**: Note on an experiment dealing with mutation in bacteria. It was noticed that the recorded ratio of occurrence in cases of meningitis of the four agglutination-types of Meningococcus corresponded very closely with the ratio of occurrence of the four iso-agglutinin groups of blood in a normal human population. It seemed possible, therefore, that by growing Meningococcus of one type in media containing human blood of different groups, mutation to other types might be induced. Experiment showed that considerable differences in type of agglutination resulted, but it was concluded that this was caused by the sorting out of races of different agglutinability from a mass culture rather than by true mutation.—Dr. **Shearer**: Electrical conductivity of bacterial emulsions.—Miss M. D. **Haviland**: The bionomics of *Aphis grossulariae*, Kalt, and *A. viburni*, Shrank. *A. grossulariae*, a pest of currant-bushes, appears to be identical with *A. grossulariae* found on the guelder rose. Experiments to see how far the descendants of the original migrants can be successfully transferred from the currant to the guelder rose, and *vice versa*, show that while the guelder-rose form can with some difficulty be cultivated on the currant, the currant form cannot be reared on the guelder rose.—J. E. **Purvis**: (1) The conversion of sawdust into sugar. (2) Bracken as a source of potash.—S. **Chapman**: Terrestrial magnetic variations and their connection with solar emissions which are absorbed in the earth's outer atmosphere.—W. J. **Harrison**: The distribution of electric force between two electrodes, one of which is covered with radio-active matter. It would appear from experimental results that the rate of ionisation per unit time due to an α particle is constant at all points of the path of the particle within the range of its ionising activity. It follows that, at a distance x from a large electrode covered with radio-active matter, the rate of ionisation is $q_0 \log (R/x)$, where R is the range of the particles. The differential equations involved are integrable in the case of the saturation current, and typical numerical solutions have been calculated

Dublin.

Royal Dublin Society, February 25.—Prof. J. Joly in the chair.—W. B. **Wright**: An analysis of the Palæozoic floor of north-eastern Ireland, with predictions as to concealed coalfields. The considerations which led up to the present search for coal beneath the basin of Lough Neagh are elaborated and supported by further evidence. These considerations were originally set forth in 1917 in a memorandum from the Geological Survey of Ireland to the Department for the Development of Mineral Resources, Ministry of Munitions. They are now extended to the prediction of coal basins in other parts of the concealed area. These basins are located at the intersection of certain well-marked north and south synclinal troughs with the continuation of the central trough-valley of Scotland, and a distinct doubly synclinal trough with Caledonian trend lying further north.

Manchester.

Literary and Philosophical Society, March 4.—Mr. W. Thomson, president, in the chair.—F. H. **Carr**: The post-graduate training of the works chemist. There was scope for institutions devoted primarily to the post-graduate training of chemical students who intended to specialise in the applied aspects of their science. In such institutions instruction would be given, not only on a wide variety of technical processes for the manufacture of chemicals, and in operations in each technical department, from the drawing office and the power house to the special chemical plants, but also in the whole question of economic and statistical control of works processes. The chemicals produced should cover an extremely wide range, and be such as might be required in relatively small quantities such as existing manufacturing firms would not find it worth while to produce. In this way the institutions in question might, in course of time, accumulate stocks of chemicals comparable in variety with those in the possession of certain German firms on the resources of which research chemists in all parts of the world have had to rely.

Sydney.

Linnean Society of New South Wales, November 27, 1918.—Prof. H. G. Chapman, president, in the chair.—Dr. R. J. **Tillyard**: Studies in Australian Neuroptera. No. 6: The family Psychopsidæ, with descriptions of new genera and species. The paper begins with a study of the wing-venation of *Psychopsis elegans*, Guérin, which is compared with the precedent tracheation of the pupal wing. From this it is shown that the family is characterised by certain specialisations not found in other families, and that the cross-venation, which consists only of a variable number of gradate series, is to be considered as a comparatively late addition to the original Prohemerobiid-like venational scheme. The character of the cross-venation is shown to be essentially variable, and the classification of the family

based on it by Navás to be quite untenable. A new subdivision of the Australian species into three genera, based on quite new characters, is given, together with descriptions of two new genera and two new species. A number of new facts are given about the very rare *Psychopsis illidgei*, Froggatt, including figures of this species at rest in two positions. The characters of the family are given in full, together with a discussion as to its affinities, fossil and recent, and a full bibliography for the Australian species, which now number eight out of a total of sixteen known for the world.—A. M. **Lea**: Descriptions of new species of Australian Coleoptera. Part xiv. Four genera and thirty-one species are described as new.—Dr. C. **Hall**: A new species or form of Eucalyptus. A single tree only has been seen, which may be a hybrid, as it has some of the characters of the Stringybarks, especially in the seedling stage, yet differs from them in others, in the mature stage, as in bark, oil, and timber.—Dr. R. J. **Tillyard**: Australian Megaloptera or alder-flies, with descriptions of new genera and species. The only known Australian species of the order Megaloptera is *Archichauliodes guttiferus*, Walker, belonging to the archaic family Corydalidæ. No species of the family Sialidæ occurs in the Oriental region, and the nearest known species is found in Chile. In this paper two interesting new genera and species belonging to this family are described, one from Maria Island, Tasmania, and the other from Mount Tambourine, South Queensland. Both are related to the Chilian form, one by the structure of its wings, and the other by its coloration. The latter (the Tasmanian species) is also closely related to the Holarctic genus Sialis. The occurrence of these insects in Australia affords further evidence of the truth of the Antarctic theory, since they could only have arrived from the south.—Dr. J. M. **Petrie**: The occurrence of methyl lævoinositol in an Australian poisonous plant. The endemic Australian plant *Heterodendron oleaefolium*, Desf. (fam. Sapindaceæ), contains the methyl ester of lævorotatory inositol. The amount isolated was equivalent to 0·65 per cent. of the dried (at 100° C.) leaves. This substance is not optically isomeric with the pinite of Maquenne, which is the methyl dextroinositol possessing a different melting point and optical rotation. It is apparently identical with Tanret's quebrachite, and had been previously recorded from three plants only—*Aspidospermum quebracho* (Apocynaceæ), *Hevea braziliensis* (Euphorbiaceæ), and *Grevillea robusta* (Proteaceæ). The occurrence of this compound is, therefore, exceedingly rare, and in great contrast to the occurrence of *inactive* inositol, which exists as a plastic substance in most plants. Heterodendron also contains a cyanogenetic glucoside.—Dr. R. J. **Tillyard**: Studies in Australian Neuroptera. No. 7: The life-history of *Psychopsis elegans*, Guérin. The complete life-cycle occupies about two years, of which the greater part is spent in the larval state. The eggs are laid singly on the bark of eucalyptus trees, and the young larva lives in cracks or crannies of the bark, whence it attacks other insects, sucking them dry with its huge, calliper-like mandibles. There are three larval instars. The full-fed larva is brownish-grey, with whitish pruinescence; the hairs of the abdomen are modified into peculiar star-like processes, which the author terms *dolichasters* and *micrasters* respectively, according to their form and origin. The mouth-parts and anal papilla of the larva are fully described. The general form of the larva is intermediate between the slender type of the Hemerobiidæ and the stout form found in the Myrmeleontidæ and allies. The jaws are large, like those of the Myrmeleontidæ, but have no internal teeth. The cocoon, which is spun from the anus, is a beautiful spherical object, resembling a pearl. The pupa is of the usual Planipennian type, with very remarkable mandibles, used for cutting the cocoon open. The emergence of the imago from the pupa is fully described and figured, as are also the mouth-parts of the imago. The paper concludes with a short discussion as to the potential economic value of the Psychopsidæ as a beneficial group of insects, the conclusion being reached that experiments with these insects in orchards of old trees might help considerably in reducing the codlin moth and other kindred pests.—Dr. H. S. H. **Wardlaw**: Note on the temperature of *Echidna aculeata*. A series of some eight hundred observations of the rectal temperature of Echidna were submitted to Galton's method of statistical analysis. The most probable temperatures were:—Spring-summer period, morning, 30° C.; afternoon, 32·6° C. Autumn-winter period, morning, 29·7° C.; afternoon, 32·3° C. The results show that the temperature-regulating mechanism of Echidna only acts while the body-temperature lies between 27·6° C. and 32·6° C. Outside these limits Echidna behaves as a poikilothermal animal.—F. H. **Taylor**: Contributions to a knowledge of Australian Culicidæ. No. 4. Synonymical notes are furnished. The Australian species of Anopheles are tabulated. Ten species, referable to six genera, are described as new.—G. P. **Darnell-Smith**: (1) An account of some observations upon the life-history of *Phoma citricarpa*, McAlp., the cause of the "black spot" of citrus fruit in New South Wales. "Black spot" is a serious disease which develops on the sunny side of trees, and upon the parts of the fruit exposed to sunlight. Two kinds of spores have been obtained—normal pycnospores, which germinate readily in suitable media, and "*x*" spores, which could not be induced to do so. The details of the formation of the pycnidia and pycnospores have been worked out. Spraying with Bordeaux, 6 : 4 : 50, followed up by sprayings with weaker solutions, controls the disease. (2) The occurrence of an inverted hymenium in *Agaricus campestris*.

BOOKS RECEIVED.

Year-Book of the Royal Society of London. No. 23. Pp. 236. (London: Harrison and Sons, 1919.) 5*s*.

Records of the Survey of India. Vol. xi. (Supplementary to General Report, 1916–17.) Annual Reports of Parties and Officers, 1916–17. Pp. 115. (Dehra Dun: Printed at the Office of the Trigonometrical Survey, 1918.) 4 rupees or 5*s*. 4*d*.

Commonwealth of Australia. Advisory Council of Science and Industry. Memoir No. 1. The Australian Environment (especially as Controlled by Rainfall). A Regional Study of the Topography, Drainage, Vegetation, and Settlement; and of the Character and Origin of the Rains. By Dr. Griffith Taylor. Pp. 188. (Melbourne, 1918.)

The Physical Chemistry of the Proteins. By Prof. T. B. Robertson. Pp. xv+483. (London: Longmans, Green, and Co., 1918.) 25*s*. net.

Neue Beobachtungen über den Erreger der Maul. und Klauenseuche die Entwicklung des Schmarotzers im Blut, Speziell in den Roten. Blutkörperchen. Von Dr. Hrch Stauffacher. Pp. 62+plates. (Zurich: Polygraphisches Institut A.-G., 1918.) 8 francs.

Coal-Tar Dyes and Intermediates. By E. de Barry Barnett. (Industrial Chemistry Series.) Pp. xviii+213. (London: Baillière, Tindall, and Cox, 1919.) 10*s*. 6*d*. net.

Verses from Fen and Fell. By Thomas Thornely.

Pp. x+98. (Cambridge: At the University Press, 1919.) 4s. 6d. net.

The Nature of Being. An Essay in Ontology. By Henry H. Slesser. Pp. 224. (London: George Allen and Unwin, Ltd., 1919.) 10s. 6d. net.

Transactions of the Bose Research Institute, Calcutta. Vol i. Parts 1 and 2. Life Movements in Plants. By Sir J. C. Bose. Pp. xxvi+251+appendix xv. (Calcutta: The Bose Research Institute, 1918.)

Le Tube Coolidge. Ses Applications Scientifiques, Médicales et Industrielles. Par H. Pilon. Pp. 83. (Paris: Masson et Cie, 1919.) 4 francs net.

Les Symbiotes. Par Paul Portier. Pp. xx+315. (Paris: Masson et Cie, 1918.) 5 francs.

Immune Sera: A Concise Exposition of our Present Knowledge of Infection and Immunity. By Dr. Charles Frederick Bolduan and John Koopman. Fifth edition. Pp. viii+206. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 7s. net.

Coal Tar and Some of its Products. By Arthur R. Warnes. (Pitman's Common Commodities and Industries.) Pp. xxii+105. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 2s. 6d. net.

Home and Farm Food Preservation. By Prof. William V. Cruess. Pp. xxiv+276. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) 8s. net.

The Human Skeleton: An Interpretation. By Prof. H. E. Walter. Pp. xv+214. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) 10s. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Prof. C. H. Lees: Fire Cracks and the Forces Producing Them.
ROYAL SOCIETY, at 4.30.—Dr. C. Chree: Magnetic Storms of March 7-8 and August 15-16, 1918, and their Discussion.—L. C. Martin: The Transparency of Biotite to Infra-red Radiations.
LINNEAN SOCIETY, at 5.—F. Lewis: Notes on a Visit to Kunadiyaparawitta Mountain, Ceylon, with List of the Plants Observed and their Altitudinal Distribution.—Miss May Rathbone: Specimens of Plants Preserved by Formalin Vapour.—H. R. Amos: Wheat-breeding with Mr. W. O. Backhouse in Argentina.
INSTITUTION OF MINING AND METALLURGY, at 5.30.—Sir Thomas Kirke Rose: The Volatilisation of Gold.—W. S. Curteis: Cobar Stope Measurement Methods.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on G. L. Addenbrooke's Lectures on Dielectrics in Electric Fields.
CHILD-STUDY SOCIETY, at 6.—Discussion opened by Mrs. K. Truelove: Training of the School Girl in Infant Care.
CHEMICAL SOCIETY, at 8.—T. M. Lowry and H. H. Abram: The Rotatory Dispersive Power of Organic Compounds. IX. Simple Rotatory Dispersion in the Terpene Series.

FRIDAY, MARCH 21.

ROYAL INSTITUTION, at 5.30.—Prof. W. W. Watts: Fossil Landscapes.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. C. Armitage: Jigs, Tools, and Special Machines with their Relation to the Production of Standardised Parts.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8, with Royal Society of Medicine (Electrical Section).—R. S. Whipple: (1) Electrical Methods of Measuring Body Temperatures; (2) The Electro-cardiograph.

SATURDAY, MARCH 22.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, MARCH 24.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. W. A. Bone: Coal and its Conservation.
ROYAL GEOGRAPHICAL SOCIETY, at 8.—Capt. Alan Ogilvie: Macedonia.

TUESDAY, MARCH 25.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: British Ethnology—The People of Scotland.
INSTITUTE OF METALS, at 4 and 8.—Annual General Meeting.—Capt. G. D. Bengough and Dr. O. F. Hudson: Fourth Report to the Corrosion Research Committee.—Dr. W. Rosenhain and D. Hanson: The Properties of Some Copper Alloys.—Lt.-Col. C. F. Jenkin: Metallurgical Information Required by Engineers.
INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Further Discussion*: J. Caldwell and H. B. Sayers: Electric Welding Developments in Great Britain and the United States of America.—W. S. Abell: Experiments on the Application of Electric Welding to Large Structures.—J. R. Smith: The Application of Electric Welding in Ship Construction and Repairs.

WEDNESDAY, MARCH 26.

INSTITUTE OF METALS, at 4.—Annual General Meeting.—D. Hanson and S. L. Archbutt: The Micrography of Aluminium and its Alloys.—Owen W. Ellis: Effect of Work on Metals and Alloys.—F. Johnson: The Influence of Cold Rolling upon the Mechanical Properties of Oxygen-free Copper.—At 8.—General Discussion on the Relation of Science to the Non-ferrous Metals Industry. Dr. W. Rosenhain: Science and Industry in Relation to Non-ferrous Metals.—W. R. Barclay: The Relationship between the Laboratory and the Workshop.—F. C. A. H. Lantsberry: The Scope of the Works Laboratory.
ROYAL SOCIETY OF ARTS, at 4.30.—Prof. A. H. Gibson: British Engineering and Hydro-Electric Development. (The Training of Engineers.)
GEOLOGICAL SOCIETY, at 5.30.
ROYAL AERONAUTICAL SOCIETY, at 8.—Lt.-Col. T. R. Cave Brown Cave: Lighter-than-Air Craft.

THURSDAY, MARCH 27.

ROYAL INSTITUTION, at 3.—Prof. C. H. Lees: Fire Cracks and the Forces Producing Them.
ROYAL SOCIETY, at 4.30.—*Probable Papers*: Dr. R. McCarrison: The Genesis of Œdema in Beriberi.—H. L. Hawkins: The Morphology and Evolution of the Ambulacrum in the Echinoidea.
CHEMICAL SOCIETY, at 4.30.—Annual General Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—The late H. R. Constantine: The Co-ordination of Research in Works and Laboratories.

FRIDAY, MARCH 28.

PHYSICAL SOCIETY, at 5.—Discussion on Metrology in the Industries. Introduced by Sir R. T. Glazebrook.
INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting), at 7.—Dr. J. F. Crowley: The Organisation of Technical Engineers.

SATURDAY, MARCH 29.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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THURSDAY, MARCH 27, 1919.

TRANSLATED SENSE AND SENSES.

Human Physiology. Vol. iv. "The Sense-organs." By Prof. L. Luciani. Translated by F. A. Welby. Pp. x+519. (London: Macmillan and Co., Ltd., 1917.) Price 21s. net.

A MAN'S name linked to a star seems certain of long-continued remembrance, joined to a rose not quite so certain. Somewhere between these extremes of permanent fame and evanescent esteem is the fate of a name associated as advisedly with a part of the central nervous system as is Luciani's with that of the cerebellum. No one can speak of Luciani's cerebellum, since that would be unforgivably personal, but it is quite impossible to talk of the cerebellum without referring at once to Luciani. It is important to remember this when dealing with Luciani's statements about the function of almost any part of the body, certainly of the nervous system. It is very important to have it in mind when considering the value of his opinions on various psycho-physical phenomena, as in the concluding chapter of this volume.

Now what has been said might be considered a sly rebuke of egotism, but that is not in the least true. There is nothing in the book but the very comprehensive range of truth examined painstakingly by its author, and no egotism whatever. The point is this, that you cannot make an intimate acquaintance with the cerebellum, an organ which has apparently no part whatever to play in displays of consciousness, without being impressed with the value of nervous factors not directly concerned in displays of consciousness, but yet obviously controlling in some degree the factors responsible for such displays. Progress towards a veneration for "subconscious" nervous factors is inevitable, and if it is not checked there is a yielding of rigid definitions sufficient to allow of some debate about "unconscious sensations and feelings." The temptation may soon become invincible to say that "these nervous processes . . . fulfil the same functions as conscious sensory processes; it follows that they come into the range of mental life, and even constitute by far the largest part of the integral content of the mind" (p. 440).

Now there is no formal connection between this passage and the cerebellum. It is merely Luciani's statement as to certain general processes associated with other parts of the nervous system, but there is wisdom, in the writer's opinion, in remembering, when reading it, that the cerebellum has apparently no direct link with consciousness, and that Luciani has probed the part it plays. He has shown that it acts as an intermediary in maintaining and modifying that distributed "tone" of the skeletal musculature which is the essence of posture and a necessary basis for the strength and precision of movement, even of *voluntary* movement. It is clear that the transition from "tone" to "voluntary movement" is through much the same scale as from "subconscious" to "conscious" feeling.

Perhaps it may be difficult to discover what all this has to do with the subject in hand, the fourth volume of Luciani's "Human Physiology," but not, I think, when the book is read, and it is well worth reading. The original work is well known as a comprehensive, scholarly, and interesting text-book. It has now, in large part, been translated into English, and edited in an able fashion for the use of English readers. In this anglicised form it is already widely appreciated, and it will be agreed that the "tone" of the original, which might, indeed, have been gravely depressed in the process, has been well maintained. The cerebellum of the book, nowhere represented in consciousness, but everywhere evident in the characteristics of attitude, is as it was. That is to say, as a whole; but there are here and there parts where—well, perhaps any critical reader of the dioptrics of the eyeball in this fourth volume will find reasons for expressing criticism. That part of the matter is exceptional in being not quite so good as the remainder.

This fourth volume on the sense-organs should prove widely useful not only to students of physiology and medicine, but also to students of psychology. As a clear and pregnant expression of knowledge of these sense-organs to be found in a volume unburdened by the inclusion of other parts of physiology, there is at present nothing so good, perhaps not even the corresponding fourth volume of Foster, which will remain for long, like Ecclesiastes, as a penetrating and abiding lesson in judgment—better than this, but which did not contain quite so much physiology.

It is true that, in the writer's opinion, the book is otherwise burdened by the concluding discussion on psycho-physical phenomena, but that is a matter which may be criticised better by students of psychology, by whom it may also be seen as the heel of Achilles, or perhaps surprisingly as a very head-piece. It is true also that there are various decisions which would not have been reached by other competent authors. It may or may not be the case that muscular sense has a content which is nothing more or less than common sensibility, and that the tectorial membrane is the primary resonator apparatus of the cochlea. There are many such conclusions, which might be discussed, and may need revision. It may be the case that there are complete neurones in the immediate vicinity of taste-buds; it is not the case that observers have found the radius of curvature of the anterior surface of the crystalline lens to be between 2·9 and 4·0 mm. (p. 287); but what of it? There may be misjudgment, there are some errors, but there are everywhere knowledge, tone, and interest.

The volume was well worth translating, and has been translated and edited very well. Here and there a statement issues as it would never come from a writer of English; here and there a slip in the translation of a technical term has

escaped the editor; but generally the combined efforts of translator and editor have been most successful. As in the other volumes, the newly appended references will prove of considerable value. J. S. MACDONALD.

SOUTH AFRICAN GRASSLANDS.

The Grasses and Grasslands of South Africa. By Prof. J. W. Bews. Pp. vi+161. (Pietermaritzburg: P. Davis and Sons, Ltd., 1918.) Price 7*s.* 6*d.* net.

THIS little volume is a contribution to the study of South African plant ecology, a subject on which Prof. Bews has already published several papers. In studying the plant succession in the grasslands of South Africa, it was found necessary to devise a simpler means of identifying the species than that afforded by the key to the genera given by Dr. Stapf in his elaborate account of the grasses in the "Flora Capensis." An artificial key was therefore drawn up, and has been included in the present volume. The test of such a key is its value to the working field botanist, and Prof. Bews states that it has met with the approval of his fellow-workers. Following the key are a number of ecological notes on the principal species in each genus, the genera being arranged in alphabetical order. These notes embody many of the author's observations, his object being to set forth the principal facts that have been ascertained regarding the part played by the more important species in the grassland plant succession, and also by means of selected examples to illustrate the general differences which are shown in morphological characters, and particularly in leaf-anatomy.

The study of a simple transverse section of the leaf of a grass may give more information as to its nutritive value than an elaborate chemical analysis of the herbage, for the latter will vary greatly according to the time of year, and even according to the state of the weather. Xerophytic grasses, in which the leaves have to protect themselves against excessive transpiration, grow less quickly, and are not so valuable for pasturage as the more mesophytic types. A notable exception to this rule is *Danthonia purpurea,* Haas grass, or hare grass. Although in general appearance this is a xerophytic plant, farmers are agreed that it is also a very nutritious species. It is low-growing, being rarely more than an inch or two in height, with deep roots and numerous densely leafy shoots, and is peculiarly adapted to growing over the surface of hard-baked clay soils. It has become completely dominant in the grass veld for miles around Molteno, in the Stormberg region, near the eastern edge of the Karroo.

The ecological notes are illustrated by somewhat diagrammatic cross-sections of the leaves of the more important species, which indicate especially the distribution of the hard, mechanical tissue. The author then gives a general sketch of the grasslands of South Africa and their development. Five main regions are considered—namely, the south-western or Cape region, the western region, the sand veld region, the Karroo and Karroid central region, and the eastern grass veld region. The boundaries of these regions are shown in a map which forms the frontispiece. Finally, a short section is devoted to some economic questions concerned with grass-burning, stock-grazing, the feeding value of natural grasses, the cultivation of grasses, and soil erosion. An appendix gives in tabular form a list of English, Dutch, Zulu, and Sesuto names. A striking feature is the large number of names in the Zulu indicating a remarkable discrimination of species.

COLLOQUIAL CHEMISTRY.

Everyman's Chemistry. The Chemist's Point of View and his Recent Work told for the Layman. By Ellwood Hendrick. Pp. x+319. (London: University of London Press, Ltd., 1918.) Price 8*s.* 6*d.* net.

MR. HENDRICK has written an extremely original book. To use his own words: "The whole thing is a sporting proposition between you, the reader, and me. If I can hold your attention until you have read it through, I shall have succeeded in my intention." It is only fair to say that, if the reader possesses ordinary intelligence, he will be able to pick up a good deal of interesting information from the book, even if he comes away from it with confused ideas as to how chemists attain their results.

The style is colloquial in the extreme, and no one need be deterred from beginning the book by any fear of high-and-dry treatment, whilst the professional chemist will derive a good deal of amusement from the manner in which facts are presented. A few of Mr. Hendrick's headings will make clear what is meant: "Polygamy in Chemistry"; "Nitrogen, its Satanic Tricks"; "The Old Horse of Chemistry"; "The Ironmaster's Torment and Why he Swears"; "The Chemical Old Mare"; "The Grand Old Tramp who Left his Mark"; "The Red-headed Halogens."

It would be a mistake to suppose, however, that Mr. Hendrick has not done a useful piece of work in writing the book. He has kept in view the fact that the man in the street is not particularly interested in theory, but prefers to learn something about practice; and it is safe to say that few popular books contain such a mass of examples of the application of chemistry to practical problems. No one who reads this work can fail to appreciate the manner in which chemistry has permeated the whole of modern society. The uses of sulphuric acid, described on pp. 86–88, should awaken the layman to the fact that, from the time he turns on the tap of his bath in the morning until he finishes his breakfast, he is continually coming in contact with materials the production of which is possible only owing to the employment of sulphuric acid. And when prose

fails him Mr. Hendrick is by no means averse to calling in the aid of rhyme.

On the purely theoretical side Mr. Hendrick's treatment of the subject is scarcely so satisfactory. It is very doubtful if a beginner would be much wiser about the ionic theory after reading pp. 22–25; and the description of the origin of stereochemistry on pp. 244–45 scarcely does van't Hoff justice, whilst Le Bel is not even mentioned in that connection.

At the present time, when it seems necessary that the general public should appreciate what chemistry does for them, even if they cannot understand how it does it, Mr. Hendrick's book should play a very useful part; and it is to be hoped that the demand for it among laymen will be a large one. Admitting the limitation which the author imposed upon himself, there can be no doubt that the book is excellent.

OUR BOOKSHELF.

Hygiene of the Eye. By Dr. W. Campbell Posey. Pp. x+344. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 18*s.* net.

It is a good sign that ever greater attention is being directed to preventive medicine, for prevention is better than cure. The proverb is specially apposite when applied to many disorders of the visual apparatus. A sound treatise on the hygiene of the eye is badly wanted—or, rather, it should be said, two such works are to be desired, one for ophthalmologists, and one for the general public. Dr. Posey's work fails to meet either requirement satisfactorily, for it falls between two stools. The chapters on the structure of the eye and on diseases of the eye are too elementary for the ophthalmologist, and scarcely intelligible to the layman. Moreover, the considerable space allotted to many diseases of which we do not know the causes, or are unable to prevent them, might have been better utilised in expanding parts more nearly related to what is commonly understood by the term "hygiene." The chapter—by the author—on school life is particularly good, and the same may be said of the chapters on artificial illumination (by Dr. Herbert E. Ives) and on daylight illumination (by Mr. W. C. Farber, an architect). These subjects would have borne further elaboration.

The author's chapters on conjunctivitis and the preventive measures to be adopted against contagion, and on wounds and injuries of the eye, are admirable. The chief industrial injuries are described, and the means of protection against them are illustrated by good photographs. There is a most interesting chapter on blindness from an economic and social point of view, and on the education and employment of the blind, by Mr. O. H. Burritt, principal of the Pennsylvania Institution for the Instruction of the Blind.

Dr. Posey is a safe guide, though he makes some dogmatic statements with which all ophthalmologists would not agree. We hope that a second edition will give him the opportunity of eliminating irrelevant material and expanding those parts which are more in accord with the title.

Elements of General Science. By Prof. Otis William Caldwell and Prof. William Lewis Eikenberry. Revised edition. Pp. xii+404. (London: Ginn and Co., 1918.) Price 5*s.* 6*d.* net.

Those who are interested in the teaching of natural science are already familiar with the publications of Messrs. Ginn and Co. in connection with the elementary and general treatment of the subject. The "Elements of General Science," by Profs. Caldwell and Eikenberry, rapidly found favour in England among the many who were growing dissatisfied with the dry and formal teaching which has been all too common. The authors succeeded in being simple without being superficial, and, with the help of the publishers, in producing a book which can be read with pleasure as well as with profit—a point which is so often overlooked.

The revised edition, which has been largely rewritten, is much bigger than the original one. Electricity and magnetism have now been included. In the forty-eight pages devoted to these subjects there are to be found figures of lighting-circuits, watt-hour meters, motor-car circuits, telephones, and transformers. Another thirty-five pages have been given to astronomy, with a series of excellent figures. The problems of nutrition and of food have received additional attention, and it is entirely in keeping with the spirit in which the book is written that five excellent charts have been prepared showing the relative costs of equivalent food-values of different things. In this, as in many other ways, the relations between the studies and the problems of everyday life have been kept prominently in view. The teacher who uses this book is not likely to be bothered by the question, "What is the use of learning this?" And yet the authors cannot be accused of having neglected true education in the effort to interest or amuse.

The Year-book of the Scientific and Learned Societies of Great Britain and Ireland. Compiled from Official Sources. Pp. viii+333. (London: Charles Griffin and Co., Ltd., 1918.) Price 9*s.* net.

The present is the thirty-fifth annual issue of this very useful work of reference. Twenty-six societies not previously included appear in this edition, and the claims of music to be numbered among the learned societies have been recognised. The compilation constitutes a record of the work done in science, literature, and art during the session 1917–18 by the various societies and Government institutions, and deserves an important place among the reference books of workers in science. The arrangement and method of indexing adopted make reference to the contents easy.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Globular Clusters, Cepheid Variables, and Radiation.

DR. SHAPLEY makes the suggestion (NATURE, March 13) that known supplies of energy become adequate to maintain stellar and solar radiation through astronomical time if we can suppose that radiation is propagated only from matter to matter, and is not radiated equally in all directions. In brief, we see the sun because the sun has in some way first seen us. Prof. Soddy points out (NATURE, March 20) that we have no direct evidence of loss of radiation into space; "experiment and observation justify only the conclusion that radiation is propagated between portions of space occupied by matter, . . . elsewhere it may not be propagated at all." Prof. Soddy is, perhaps, on safe ground as regards laboratory experiments, but it seems to me that astronomical evidence is against him.

We see star clusters by light which has journeyed for 200,000 years to meet us; by what mechanism could this light calculate 200,000 years ago that today we should be where we are? There seem to be only two possibilities open: the cones of light projected from matter to matter may be more than big enough to catch the matter aimed at, or light may not travel in straight lines, adjusting its course as it proceeds on its voyage through space.

Under the first possibility the whole advantage of Dr. Shapley's hypothesis disappears. We see, say, 10^9 stars, so that, presumably, 10^9 stars see our sun. Suppose our sun sends out 10^9 cones of light each big enough to be fairly sure of catching a star. Stellar velocities being of the order of 10^{-4} times that of light, each cone must be of angle about 10^{-4} radians, and 10^9 such cones just about fill up the solid angle of space. The hypothesis has lost its only advantage.

Suppose, as an alternative, that the presence of a star in some way guides the light from another star towards it. The path of a ray of light is no longer a straight line, but a sort of "curve of pursuit." To catch the light from a star we ought no longer to point our telescopes $20{\cdot}4'' \times \sin\lambda$ forward along the earth's path in space, but an equal amount backwards. The aberration-correction becomes reversed, and all determinations of parallax, proper motions, etc., become illusory. One puzzle might be solved, but at the cost of shattering almost the whole fabric of astronomy.

Thus if Dr. Shapley's very strong case for a long time-scale is accepted as proved, I think we must look for a new mechanism of production of energy; the problem is not solved by a mere rearrangement of the expenditure. In looking for possible new sources of energy, we ought to remember that our knowledge of physics is derived wholly from experiments conducted at the surface of a planet with the aid of light emitted from the surfaces of sun and stars. Our whole knowledge of physics is "surface-physics"; it is the special physics of conditions in which radiation is free to scatter into space, so that radiation pressure is negligible. There may be a more general physics applicable inside a star, and this may contain sources of energy unknown to us. There is, for instance, a possibility I suggested in 1905, which Dr. Shapley considers "bizarre." Conservation of mass and of energy may be only phenomena of "surface-physics." Inside a star, matter and energy may be interchangeable. The intrinsic energy of an electron being mC^2, the transformation of 1 per cent. of the sun's mass into energy would yield up radiation enough for 150,000,000,000 years.

J. H. JEANS.

March 22.

THE suggestion of Dr. Harlow Shapley and Prof. Soddy that radiation only occurs between portions of space occupied by matter is difficult to reconcile with the very considerable cooling by radiation that takes place on a cloudless night, when, on the supposition in question, it should be almost negligible—less, indeed, than with an overcast sky.

Such a law of radiation would have other strange results equally inconsistent with experience.

JOHN W. EVANS.

Imperial College of Science and Technology, South Kensington, March 21.

Scientific Research at St. Andrews University.

THE president of the Edinburgh Royal Society in his address alluded to in NATURE of March 13 has done full justice to the St. Andrews University Chemical Research Department, which owes its prosperity to the munificence and the example of my late colleague, Prof. Purdie, and also to his relatives. It likewise throughout has had the unvarying support of the University Court, which allocated a large sum (more than 5000*l.*) from the Carnegie Trust Grant to the University for its maintenance.

But there is an older research department in the University of St. Andrews which has been overlooked by Dr. Horne, viz. that for research in marine zoology and the fisheries at the Gatty Marine Laboratory, the oldest marine laboratory in Britain, and the scientific work emanating from which will speak for itself. Its trained workers hold, and have held, important posts in the three centres of the kingdom and in the various Colonies, as well as in foreign countries. That it should have been severed from connection with the Government by the Secretary for Scotland in 1896 (after twelve and a half years' labour), when the new building was erected on University ground, seems a paradox when the heavy expenditure (which still goes on) in subsidising the International Fisheries Council is remembered.

Chemistry research, adequately endowed, can be carried out anywhere, whereas work in marine zoology and the fisheries can nowhere be more successfully pursued than in the bay and on the shores of St. Andrews, where Prof. John Reid, the distinguished physiologist, first dealt with its riches. There the pulse of the North Sea is daily felt, and every student of Nature is beckoned to engage in the elucidation of the endless variety of its fauna and flora. It is to be hoped that the University Court, which has closed the laboratory at present from motives of economy, will soon reopen it.

W. C. MCINTOSH.

Maceration by Tryptic Digestion.

WITH reference to the paragraph on the method of maceration by tryptic digestion in NATURE of March 6, p. 9, it may be of interest to your readers to learn that further work on the process has shown that equally good results are obtained by the use of Messrs. Allen and Hanbury's *Liquor Trypsini Co.* This costs only 3*s.* 9*d.* a bottle, and the requisite strength is obtained by adding 1 c.c. to a litre of water. The procedure is in other respects identical with that previously described. The trouble of dissolving the powder is thus avoided, and the cost is reduced from 1*s.* per litre to rather less than ½*d.*, so that the method becomes practicable for use on a large scale.

On the whole, the optimum temperature is a high one, about 55° C., and this has the additional advantage of somewhat reducing the unpleasant smell.

KATHLEEN F. LANDER.

Zoological Society of London, Regent's Park, N.W.8, March 19.

OPTICAL GLASS.

ONE of the surprises of the great war has been the revelation to the majority of people of the extent to which a nation may be absolutely dependent for the conduct of the war on an industry which, in its magnitude, may seem quite insignificant, but, owing to the technical experience underlying it, cannot be acquired in a short space of time. In the forefront of such vital industries is the manufacture of optical glass. However great the other resources in men and material may be, it would be quite impossible to wage successful warfare without adequate supplies of optical glass for binocular field-glasses, range-finders, artillery sights, photographic lenses for aircraft, etc. It is of interest to trace briefly the history and practice of this important "key" industry, and to consider how the nation will be situated as regards the supply of optical glass when peace is restored and it will again be in competition with German glass.

The manufacture of homogeneous glass suitable for optical instruments dates practically from the time when the achromatisation of lenses became possible. Up to that time selected pieces of sheet glass served for the manufacture of the crude optical appliances then in use. Switzerland was originally the home of the optical glass industry, when, at the beginning of last century, its manufacture was undertaken by Guinand, who discovered how to make glass homogeneous by stirring. For a short time the production of optical glass was carried on by Fraunhofer at Munich, and, about the middle of last century, Messrs. Chance Brothers, of Birmingham, with the assistance of M. Bontemps, who had worked in France with Guinand's eldest son, commenced the manufacture of this material. Methods of manufacture have not materially changed since that date, but more uniform results are now obtained, in what was formerly a very hazardous process, by the use of gas furnaces, careful temperature control, and attention to detail in every direction.

Optical glass is made by melting the necessary ingredients at a very high temperature in clay crucibles or pots. When the mass has fused to a clear liquid free from bubbles, the molten glass is stirred for a long time by a thick fireclay rod. The viscosity of the liquid makes perfect admixture by eddy currents and diffusion a slow process, and all the time the glass is exerting a corrosive action on the sides of the pot and stirrer, and the products of this action tend to contaminate the glass and produce striæ.

When it is deemed desirable to discontinue the stirring process, the pot is allowed to cool. When cold, the glass in the pot is found to be much fractured, and falls to pieces when the pot is "broken down." The fragments of glass are heated until they soften, and then reduced to suitable shape by moulding. After being ground and polished, the lumps are examined for striæ, and perhaps one-quarter of the mass may be found to be of good optical quality. When optical glass is required in the form of discs or prism blocks, selected plates are brought to the required form by a second moulding process.

The discs, etc., must then be annealed, or very slowly cooled, so that the stresses which would be set up in the glass by rapid cooling may be reduced to a minimum and have no harmful effect on the performance of the optical component into which it is fashioned by the optician.

FIG. 1.—A stage in the manufacture of optical glass. On the right-hand side is a pot or crucible in which glass has been founded which has been allowed to cool and is now ready to be broken down. On the left hand will be seen a pot of glass which has been partially broken down.

The production of good yields of high-quality glass, even of the oldest crown and flint types, is an operation which requires skill and long experience. Apart from this, the present very varied requirements of opticians necessitate the production of varieties of glass which are widely different in composition, and the manufacture of glasses having the optical constants requisite to meet the needs of the lens computer calls for expert scientific assistance.

During the first half of last century the requirements of opticians were fairly satisfied by a limited range of glasses. Scientific work on the production of new types was carried out in this country for many years by Harcourt and Stokes, but, though admirable in its scope, this work had a

somewhat limited end in view—namely, the reduction of secondary spectrum—and met with no considerable success.

FIG. 2.—Disc of crown glass, 28 in. in diameter, made by Messrs. Chance Brothers just before the war.

The English firm and that of Mantois, of Paris, held the field up to about 1880. About this time, owing to the happy collaboration between the very distinguished optician, Abbe, and the able chemist, Schott, extensive research on the subject of new optical glasses was carried out in Germany.

The advent of dry-plate photography and the special corrections desirable in camera lenses, as well as in microscopic objectives, gave a great stimulus to the work of these investigators, and their researches, carried out with more perfect technical appliances, had a wider aim in view than those of the English experimenters. The results obtained were of such promise and importance that Government assistance was forthcoming in the setting up of works for the manufacture of new glasses on a commercial scale, and the painstaking efforts of these men of science in overcoming the difficulties involved were eventually rewarded with well-deserved success.

As a result, opticians were compelled for many years to go to Germany for glasses having special properties such as were absolutely necessary for them in the design of the better types of certain optical instruments. And, as many of the more important instruments during the latter part of last century were of German design, the firms concerned naturally transferred almost the whole of their orders from the English and French firms to Schott and Co., of Jena, and, in fact, so far as the military requirements of Germany were concerned, they were compelled to do so by the German Government.

It may be said, however, that the products of the English and French firms, as regards the older varieties of optical glass, were never surpassed by the Jena firm. This is evidenced by the fact that the English and French firms produced the great majority of the large discs for the giant astronomical refracting telescopes constructed during the last forty years. At the British Scientific Products Exhibition recently held in London and Manchester, a fine disc of crown glass, 28 in. in diameter, which was produced immediately before the war, was exhibited by Messrs. Chance Brothers.

The British firm, in particular, was slow in taking up the manufacture of the newer types of optical glass, and had to encounter serious disadvantages in coming late into the field in this respect, as also in being unable to obtain any Government assistance. The great value of the previous production of optical glass in this

FIG. 3.—The packing and dispatching department of Messrs. Chance Brothers' works, showing a large variety of moulded discs, prisms, etc., required for war purposes.

country, however, was felt at once on the outbreak of war, when Messrs. Chance Brothers were able to extend their resources, and, without outside assistance of any kind, to develop the manufacture of all the types of glass required by opticians, including some of the most extreme of the Jena varieties, which became necessary owing to an extended programme of work undertaken in connection with photographic lenses for aircraft.

In 1916 it was thought desirable (partly as a precaution against the results of possible aerial attack) that, for the manufacture of this important material, the nation should not be dependent on a single source of supply, and the Derby Crown Glass Works, Ltd., were encouraged to commence its manufacture, and they have already been successful in producing a number of types of optical glass of good quality. Still more recently the United States, though, to a large extent, dependent on English and French resources for optical glass for war purposes, have commenced its manufacture on their own account, and have already achieved some success in this direction.

Such are the demands of war on the optical industry that towards the end of hostilities one British firm was producing twice as much optical glass as the world's total output previous to the war. In considering, further, the position of the industry after the war, it is therefore obvious that there are resources in this country for the manufacture of all the optical glass which will be required by our opticians. Nor need there be any apprehension regarding the ranges of glass which will be available for the use of the lens designer. Without any notable exception, Messrs. Chance Brothers have been able, by their previous experience and by the work of their research laboratory, established during the war, to produce glasses which, in their optical constants, cover the full range of glasses mentioned in the Jena list for 1913.

The further development of the optical glass industry would appear to be well provided for in view of the practical research work carried out by the manufacturer and of the more general work conducted by the British Scientific Instrument Research Association, recently formed under the direction of the British Optical Instrument Manufacturers' Association. To maintain the supremacy of the nation in regard to this manufacture, however, it is not only necessary to be able to produce the material of good quality, but it is further essential that it should be produced at prices which will compete with those of foreign firms. With the greater time which manufacturers will be able to devote to the subject with this end in view, there should be no difficulty in arriving at a satisfactory solution of this point.

However large the possible output and however perfect the quality of British optical glass, the future of the industry can be assured only if British opticians are able to achieve and maintain supremacy in home and foreign markets by excellence in the design and workmanship of their instruments of precision and by cheapness of manufacture of the more common optical products. Fortunately, there has been full appreciation of this aspect of the situation, and in the Imperial College of Science and Technology there is now a Technical Optics Department, under the direction of Prof. F. J. Cheshire, and with the courses of lectures given there, including those by so able a computer as Prof. A. E. Conrady, the department should greatly assist in ensuring that this country is well supplied with expert designers of optical systems. The wide increase in membership of the Optical Society and the valuable papers contributed thereto by workers in the National Physical Laboratory and in the research departments of academic institutions and firms are also of happy augury for the future.

Before the war, computers designed lenses to utilise existing Jena glasses of definite optical constants. It would be undesirable and unfair to British manufacturers to reverse this process completely. Computers should be prepared to do a certain amount of recalculation, and so avoid imposing on the manufacturers the wasteful task of producing a glass to imitate exactly the hazard constants obtained in the particular foreign melting used previous to the war.

SULPHURIC ACID AFTER THE WAR.

THE Departmental Committee on the Post-war Position of the Sulphuric Acid and Fertiliser Trades, which presented a report, with certain omissions and modifications deemed necessary in the national interest, in February of last year (Cd. 8994), has now issued an amended and complete edition (Cmd. 23) in substitution for that paper.

The changes are not numerous, although important for the consideration of the matters with which the Committee was concerned. They relate principally to the pre-war production of sulphuric acid; to an enumeration of the principal consuming trades and their estimated annual consumption prior to 1914; to the sulphuric acid trade during the war, showing its enormous expansion; to certain statistical facts connected with the development of the zinc industry during the war, and its influence on the acid situation; to the probable post-war consumption of sulphuric acid; and, lastly, to a list of acid factories owned or leased by the Government, with their situation and output.

Although certain of the matters now dealt with were probably known more or less accurately to German manufacturers who had pre-war business relations with this country, or kept themselves informed of its trade developments, it was obviously undesirable that many of the facts brought to the knowledge of the Committee should be published whilst we were actually at war. Sulphuric acid is all-important as a prime material in the manufacture of munitions, and it need scarcely be said that the enemy would have welcomed official information as to how far this country was able to meet the sudden and unex-

pected demand on her resources occasioned by a struggle of such magnitude as that in which she was involved. The Germans began the war in the confident belief that the resources of all their enemies would be either quickly exhausted, or incapable of full utilisation before the lightning-stroke they contemplated should have determined the issue. They will learn the extent of their miscalculation, at least as regards sulphuric acid in this country, should they care to study the figures which the Committee now makes known.

The actual consumption of sulphuric acid in Great Britain before the war is not known with certainty, as no detailed statistics are available, but the Committee has been at pains to collect information from authorities, and gives the following table showing approximate estimates of the annual pre-war consumption by the more important trades:—

	Tons 100 per cent. acid per annum	Tons equivalent chamber acid
Superphosphates ...	300,000	450,000
Sulphate of ammonia ...	280,000	420,000
Bleaching powder, hydrochloric acid, alkali, and alum	186,000	279,000
Iron pickling	70,000	105,000
Recovery of grease ...	20,000	30,000
Copper sulphate ...	25,000	37,000
Dyeing and bleaching ...	25,000	37,000
Dyes	Very small	—
Oil refining	20,000	30,000
Explosives	30,000	45,000

"Iron pickling" refers to the use of the acid in the tinplate and galvanising trades, and "recovery of grease" to its employment in connection with the treatment of wool-washing liquors, etc., in the textile trades. These figures, although admittedly only approximate, are valuable as showing the relative distribution of the main amount of sulphuric acid produced in this country. It will probably be news to many people that considerably more than half is needed for the manufacture of fertilisers.

In addition to the trades mentioned, sulphuric acid is used in a number of minor industries, but no exact estimate can be formed of the aggregate amount. The Committee is probably within the mark in assuming that the annual production in the British Isles before the war was about 1,000,000 tons of 100 per cent. acid, or 1,500,000 tons of chamber acid. It considers that this quantity may also be taken as the national consumption, since both the export and import of sulphuric acid were negligible in amount.

Sulphuric acid goes into industry of several degrees of strength, by far the largest amount being used in the form of "chamber acid"—that is, as produced directly in the lead-chambers, and without subsequent concentration. The concentrated acid of 95 per cent. strength was produced to the extent of 75,000 tons. What is known as "contact acid" or oleum amounted to about 22,000 tons per annum. It is used mainly in the manufacture of explosives and dyes, and was produced only by three firms.

No estimate of the actual amount of sulphuric acid employed for munitions since 1914 is furnished by the Committee, but some idea of its magnitude may be gained from certain figures adduced by them to show the post-war position of the industry after allowing for a reversion to normal working conditions.

	Pre-war	Post-war
	(Tons 100 per cent. acid per annum).	
Oleum	22,000	450,000
Chamber	1,040,000	1,265,000
	1,062,000	1,715,000
Equivalent chamber acid	1,593,000	2,572,000

It will be seen that the amount of "oleum"—the variety of special importance in the manufacture of munitions—increased more than twenty-fold in the course of the war, and mainly during the last two or three years of it. But a considerable amount of concentrated chamber acid was also gained by restricting supplies to manufacturers of superphosphates and to certain other trades. Large oleum plants were erected by the Government in connection with its explosive factories, and the productive capacity of the plant either owned or leased by the Ministry of Munitions is estimated by the Committee at 315,000 tons 100 per cent. acid, equivalent to 472,000 tons chamber acid, per annum, or rather less than half the gross estimated surplus.

In its previous report the Committee considered what steps might be taken to safeguard the sulphuric acid industry after the war in view of the position created by it. Not only has a large amount of new and valuable plant been erected—more than peace conditions can utilise—but a further extension of the industry is imminent, owing to the prospective development of zinc production in this country, and the consequent necessity for dealing with the sulphurous acid produced in roasting the concentrates. Some time before the war Herr Hasenclever, a well-known German chemical manufacturer, in the Hurter lecture to one of the sections of the Society of Chemical Industry, pointed out what had been the result on the price of sulphuric acid of the action of the German Government in compelling the zinc manufacturers of Silesia to condense their acid fumes—an admitted necessity. It is quite evident from the tenor of its report that the Committee is apprehensive of a similar result here. There is likely to be a glut of sulphuric acid and a serious depreciation of prices for some time to come unless plant is scrapped or shut down. The most obvious remedy is a great extension of the fertiliser industry, but this is not immediately possible, unless there is a more rapid development of the by-product coking industry, and a consequent increase in the production of ammonia, and larger available supplies of mineral phosphates. The Committee, of course, recognises this fact, and in its present report it makes this additional recommendation: "That the Government should take immediate steps by international com-

mercial treaties or otherwise to secure an effective and permanent control or command of an adequate supply of phosphate rock, and that arrangements should be made in advance for the importation of large quantities of phosphate rock immediately on the termination of the war."

There is more in this recommendation than meets the eye. Certain of the forfeited Colonial possessions of the Germans contain valuable deposits of phosphate rock, and others are known which ought to be, and doubtless would be, exploited if a demand were created. It is to be hoped that the Government may be in a position to act promptly upon this recommendation, and thus enable at least some portion of the large and valuable plant created by the war to be utilised before it is too late, for the benefit of chemical industry and the welfare of agriculture.

NOTES.

THE Marconi Wireless Telegraph Co. is to be congratulated on having established experimental wireless telephonic communication between Clifden, Co. Galway, in Ireland, and Cape Grace, in Canada. This is not surprising after the company's feat last year of establishing wireless communication between England and Australia—a distance of 12,000 miles. The improvements which have been made in thermionic valves—for instance, the reduction of the air-pressure in the valve to the one-hundred-millionth of a millimetre of mercury—have increased their sensitivity enormously. In addition, by connecting them "in cascade" there appears also to be no limit to the sensitivity that can be attained. The Australian results were obtained by using three small Marconi Q-type valves in cascade. Wireless telephonic transmission is specially interesting, as it is free from many of the defects of ordinary telephony, in which sound distortion presents serious difficulties over long cables. There seems no reason to doubt that in a short time wireless telephony will be established between every country on the globe. The necessity for well-thought-out international laws to regulate this traffic is therefore pressing.

VISCOUNT HARCOURT deserves the thanks of all interested in the restitution of our museums for his persistent worrying of the Government and for his letter to the *Times* of March 22. In answer to his question on March 19 he was informed that the London Museum would be restored to the public in a few weeks. "Temporary buildings are to be erected in the suburbs for the staffs now in occupation" of the Imperial Institute and the Tate Gallery, "but the new accommodation cannot be available for at least six months." The Education Department, it is expected, will soon return to Whitehall. There is, however, "no immediate prospect" of vacating the National Portrait Gallery, Hertford House, or the remaining galleries of the National Gallery and the British Museum. As regards the last institution, an article in the *Times* of March 21 did well to remind the public that the greater part of the old building is now accessible. The situation, no doubt, is difficult, as Sir Alfred Mond has explained in a long statement to the Press, but the agitation has succeeded in speeding up the Government, and once more we may exclaim, "Thank God, there is a House of Lords!"

THE absence of recognisable meteorites from the series of stratified rocks is a notable fact, possibly due to the disintegration of the meteoric substance, which even in our museums displays a deplorable tendency to decay. The British Museum has, however, recently acquired among slices and fragments of various recent falls or finds a slice weighing 362·5 grams of the meteoric iron which was found in January, 1905, on Claim No. 7, Skookum Gulch, 9½ miles S.E. of Dawson, Klondike. This, as well as another meteoric iron found in 1901 on Gay Gulch, in the same neighbourhood, was lying deep down in the so-called "white-channel gravels," which are the oldest high-level gravels of the district, and are believed by Mr. R. G. McConnell to be of Pliocene age or older. The original specimens are in the Museum of the Geological Survey at Ottawa, where they have been examined by Mr. R. A. A. Johnston (1915), who infers from their similar structure and composition that they formed part "of a single meteoric shower which took place back in Tertiary time."

AN address on "Acute Pneumonic Tuberculosis" will be delivered by Sir W. Osler before the Tuberculosis Society at 8.30 p.m. on Monday, April 28.

NEWS has reached us of the death on March 8, at thirty-seven years of age, of M. Jacques Danne, editor of the well-known French journal *Le Radium.*

WE learn with regret from Tuesday's *Times* that Sir E. C. Stirling, F.R.S., professor of physiology in the University of Adelaide, and director of the South Australian Museum, died on March 20 at seventy years of age.

NEXT Thursday, April 3, Prof. A. Findlay will deliver the first of a course of two lectures at the Royal Institution on colloidal matter and its properties. The Friday discourse on April 11 will be delivered by Sir J. J. Thomson on piezo-electricity and its applications.

THE Paris correspondent of the *Times* announces the death on March 19, at seventy-seven years of age, of Prof. F. H. Hallopeau, member of the Paris Academy of Medicine, and author of a treatise on general pathology and numerous papers on therapeutics and dermatology.

THE death is announced, in his seventy-sixth year, of Prof. Charles L. Doolittle, who was professor of astronomy at Lehigh University from 1875 to 1895, and at the University of Pennsylvania from 1895 to 1912. Prof. Doolittle was treasurer of the Astronomical Society of America from 1899 to 1912, and was the author of notable papers on the variation of latitude, the constant of aberration, and related subjects.

THE Regional Association will hold its next conference at Malvern on April 9–16. The object of the conference is to study the Malvern region from the physical, historical, and social points of view and to facilitate the interchange of ideas of all who are interested in the study of their environment. A series of lectures and excursions has been arranged. The local secretary is Mr. E. W. Harris, The High School, Malvern. The first annual report of the association, a copy of which has been sent us from the office, 11 Tavistock Square, W.C.1, shows that a considerable amount of work has been done in the past year in spite of difficult circumstances. In many parts of the country the intensive survey of regions has been undertaken. It is hoped that some of these surveys will soon be ready for publication in view of their important bearing on local schemes of social betterment and reconstruction.

THE annual general meeting of the Ray Society was held in the rooms of the Geological Society on March 13, the president, Prof. W. C. McIntosh, in

the chair. Resolutions of regret at the death of Dr. F. Du Cane Godman, treasurer for fourteen years, and of Canon A. M. Norman, a former member of the council, were passed. The treasurer, Dr. S. F. Harmer, was congratulated upon his appointment as director of the Natural History Museum. It was announced in the report of the council that vol. iv. of the "British Fresh-water Rhizopoda and Heliozoa," by G. H. Wailes, was ready for binding, and that the "British Orthoptera," by W. J. Lucas, and vol. i. of the "British Charophyta," by James Groves and Canon Bullock-Webster, were in the press. Prof. E. B. Poulton was elected a vice-president, and Dr. A. W. Alcock, Dr. G. B. Longstaff, and Mr. A. W. Oke were elected new members of the council. Prof. McIntosh, Dr. Harmer, and Mr. John Hopkinson were re-elected to their respective offices of president, treasurer, and secretary.

On March 18 the Illuminating Engineering Society held its tenth anniversary dinner, the president, Mr. A. P. Trotter, presiding. The toast of the society was proposed by Mr. Thos. Goulden, senior vice-president of the Institution of Gas Engineers, and seconded by Mr. C. H. Wordingham, president of the Institution of Electrical Engineers, both of whom referred to the valuable, impartial platform which the society affords for the discussion of topics of common interest to both gas and electrical engineers. In replying to the toast, the president remarked that the society's activities have expanded continuously since its foundation, and it has frequently brought together those interested respectively in the design and manufacture of lighting apparatus and those who use it. Mr. F. W. Goodenough proposed the toast of kindred societies, represented at the meeting by the Royal Society, the Royal Society of Arts, the British Science Guild, the Council of British Ophthalmologists, the Royal Institute of British Architects, the Institutions of Gas, Electrical, and County and Municipal Engineers, and the Electrical Contractors' Association, on behalf of which Sir George Beilby, Col. J. Herbert Parsons, and Mr. A. A. Campbell Swinton replied. Mr. Gaster, in proposing the toast of "The Guests," referred especially to the important report issued by the Home Office Departmental Committee on Lighting in Factories and Workshops in 1915, and expressed the hope that in the near future there will be definite legislative reference to the provision of adequate lighting in factories in the interests of health, safety, and efficiency of work. In the United States such legislation has been adopted by five of the States, and it is to be hoped that this country, which took the initiative in this matter before the war, will regain the lead.

In an article entitled "International Use of Patent Searches," published in the Journal of the Patent Office Society for February last, Mr. Scott H. Tilly directs attention to a wish expressed in an address given by the director of the Canadian Patent Office to the employees of the United States Patent Office to the effect that the Canadian Patent Office might officially have the benefit of searches made in the United States in respect of any matter in relation to which applications are also filed in Canada. It is argued that, since the great majority of applications filed in Canada are filed in substantially the same form in the United States of America, one search as to novelty should be sufficient; and further, since the facilities for search are better in the United States than in the Dominion, the single search suggested should, in the interests of economy and efficiency, be conducted at Washington. Mr. Tilly desires to see the matter carried further still, and suggests that it is worthy of investigation whether it could not be made profitable for Washington to report as to novelty, not only to Canada, but also to England and to the other British Colonies having patent systems. However, as it is the standard of novelty accepted in any particular country, and not the form in which applications are filed there, that determines the value of the examiner's work, no useful purpose would be gained by the adoption of the proposals for instituting a single search. The legal standard of novelty accepted in this country has, from the inventor's point of view, many advantages over the standard adopted in the United States; therefore, by resorting to the protection of the British patent law inventors in our Colonies stand to gain. Further, in cases where the Colonies are unable to provide for efficient search for their own purposes, the proper remedy seems to be for the Imperial Government to make suitable arrangements for conducting patent searches in London on behalf of those Colonial Patent Offices which may desire to avail themselves of the exceptional facilities existing in this country for such a purpose.

Dr. W. H. Rivers has reprinted from the Bulletin of the John Rylands Library (vol. iv., 1918) a lecture entitled "Dreams and Primitive Culture." He discusses the most essential feature of Freud's theory, according to which "the dream as we remember it, and record or relate it—the manifest content of the dream—is the product of a process of transformation. By means of this process the motives producing the dream—the latent content of the dream, or the dream-thoughts—often find expression in a form differing profoundly from that by which they would be expressed in the usage of ordinary waking life." The next process, that of symbolisation, "implies a relation between the underlying motive of the dream and the form in which this motive is expressed, the relation being of such a kind that the image of the manifest dream is a concrete symbol of the thought, emotion, or sentiment which forms its latent motive." On this analogy, among savage peoples, dramatic representation goes far more deeply into the texture of their lives than would appear if we attend only to its place in religious ritual. This would go some way to explain why rude rites and customs have their origin in the unconscious, and it enables us to understand why it is impossible, among peoples of the lower culture, to obtain any rational explanation of rites and customs, even when such explanation seems to us to be obvious.

In a recent issue of the *Rivista di Antropologia* Prof. Giuffrida-Ruggeri makes a contribution ("Se i popoli del mare delle iscrizioni geroglifiche appartengano tutti all' Italia") to the much-discussed problem of the identity of the Mediterranean peoples who took part in the conflicts with Egypt during the Nineteenth and Twentieth Dynasties. He agrees with A. J. Reinach as to the history of the Etruscans. As Seneca wrote, *Tuscos Asia sibi vindicat.* At the time of the great Mediterranean turmoil (thirteenth and twelfth centuries B.C.) the "Tursha" or Etruscans were among the people who set out from their Lydian home and attacked Egypt. "They came to the Nile Delta with their women and children, and were evidently looking for land to colonise, but were 'thrown into the sea' (*circa* 1260 B.C.) by the armies of Merenptah, and again by Ramses III. (*circa* 1190 B.C.). These failures must have diverted them in another direction, towards the barbaric regions of the west. So it was that about the eleventh century B.C. their boats reached the western peninsula, the fabled Hesperia, and they occupied Tuscany." But Prof. Giuffrida-Ruggeri disagrees with Reinach's claim that their Lydian neigh-

bours, the Shardana, occupied Sardinia at the same time. His reason is that Sardinia was "a very difficult country to occupy, strongly fortified, and inhabited by a fierce population." The Sardinians were a Mediterranean people who "provided war material for the confederation of the 'peoples of the sea' who attacked Egypt. They took part in this attack with valour, such as their descendants have recently shown in the battles of the Isonzo."

IN *Science* (vol. xlviii., No. 1250, December 13, 1918) Mr. S. O. Most discusses the problems, methods, and results of the study of behaviour. He thinks that from time to time it is advantageous to trace the course of scientific development and adjust plans for the future. He gives a historical review of the study of behaviour from the unscientific acceptance of the soul as the controlling agent of all activities—the current view of pre-Renaissance times—through the seventeenth-century belief in the purely mechanical action of men and animals—a belief which inspired much research—to the nineteenth-century realisation of the complex nature of the problem. The problem is a practical one, as is evidenced by the work of such societies as that of the anti-vivisectionists, who, though often inconsistent, yet base their activities on an assumption of the likeness between animals and man with regard to pain. The author urges the claims of a comparative study of behaviour in spite of its anthropomorphic tendencies. He thinks that the differences between the mechanists and vitalists are mainly verbal, the one believing that all reactions are completely determined by material configurations, the latter that the reactions are not thus completely determined, the differences, though, lying in an ambiguous use of mechanical reduction. Whichever view is held, the scientific worker is in equal degree bound to ascertain by experimental methods every possible sequence of phenomena ending in reactions. Hitherto all attempts to reduce animate responses to physicochemical principle have resulted in evidence which shows that a great majority of such responses are, in a measure, mechanically determined. To ascertain the extent of this determination is an important problem both for the vitalistically and the mechanistically inclined men of science.

IN the February issue of *Reveille* (No. 3) "Economist" discusses "the cost of consumption." The author points out that in ten years the deaths from tuberculosis in England and Wales are not far short of the total deaths in the British and Dominion forces during the war. He pleads for the extension of colony treatment, such as obtains at Papworth, where the consumptive, after a period of observation in a sanatorium, is allowed by slow degrees to begin working, preferably at his old occupation, or, if that is unsuitable, at some new occupation which does not require too long a period of training. After a few months, when ready to leave the sanatorium, and if a suitable case, the patient is encouraged to settle on, or in the neighbourhood of, the colony. This means subsidised labour, a costly matter, but probably no more costly than allowing the patient to die, while the ultimate gain by the reduced risk of infection is very great.

A PAPER by Harriette Chick, E. Margaret Hume, Ruth F. Skelton, and Alice Henderson Smith on the prevention of scurvy (*Lancet*, November 30, 1918) is of some botanical as well as medical interest. "Lime-juice" has a well-known reputation as an anti-scorbutic, dating from the eighteenth century, and there is every reason to believe that it was, in fact, the use of "lime-juice" which was responsible for the disappearance of scurvy from the British Navy in the early part of the nineteenth century. Towards the end of that period, however, various Arctic explorers became sceptical about its value, and it has been subjected to much adverse criticism as a prophylactic or therapeutic agent in the late war. The authors found in animal experiments that the current lime-juice is of very little value, but that lemon-juice is effective in preventing scurvy in guinea-pigs. The historical researches of Mrs. Henderson Smith cleared up the puzzle. The original "lime-juice" came from the Mediterranean, and was derived partly from the sweet lime (*Citrus medica* var. *limetta*), but chiefly from the lemon (*C. medica* var. *limonum*); it was what we should now call "lemon-juice." About 1865 the cultivation of the sour lime (*C. medica* var. *acida*) had become a considerable business in the West Indies, and the Admiralty patriotically transferred its contracts from Malta and Sicily to English firms; they got what we now call "lime-juice," and it was useless. In the same series of nutritional investigations made at the Lister Institute, Harriette Chick and Mabel Rhodes (*Lancet*, December 7, 1918) direct attention to the fact that the most potent anti-scorbutics are all crucifers—cabbage, "scurvy grass" (Cochlearia), and "cresses" of various kinds; swedes are much more efficient than carrots (Umbelliferæ) or beetroots (Chenopodiaceæ).

THE efforts made to introduce the use of bracken rhizomes as food for stock do not receive much encouragement from the results of experiments with pigs and poultry reported in Bulletin No. 89 of the West of Scotland Agricultural College. In the experiments with pigs an increased live-weight was certainly secured by the use of the bracken rhizomes, but this represented only a very meagre return. In the case of poultry the results as indicated by egg-production were entirely disappointing. In both cases the experiments were admittedly not on a sufficient scale to warrant definite conclusions, but the outlook for the promotion of bracken to the dignity of a fodder crop does not appear hopeful.

MR. G. T. MOORE (Annals of the Missouri Botanical Garden, vol. v., No. 3, 2 plates, 1918) gives an account of a new wood-penetrating alga, *Gomontia lignicola*, found on a yellow-pine board in a fresh-water pond near Woods Hole, Massachusetts, the study of which has cleared up several points in the life-history of the genus. The plant consists of unbranched cylindrical filaments in which a striking appearance is produced by the concentration of most of the chlorophyll in the terminal cell, the remaining cells being so devoid of colour as to have the appearance of a fungal hypha. The plant is reproduced by zoospores, which are formed in large numbers in sporangia of extremely irregular outline, and either germinate directly to produce a new filament or form resting-spores. The latter are very irregular in size and shape, brilliantly green and full of starch, and may rest for months, or even years, before germination.

ONE of the most destructive of recent Italian earthquakes, of which little was heard at the time, occurred in the Upper Tiber valley on April 26, 1917, at 9.40 a.m. (G.M.T.). Though the area of damage, according to Prof. Oddone (*Boll. Soc. Sis. Ital.*, vol. xxi., 1918, pp. 9–27), contains only about seventy-five square miles, there was within it a small district in which the intensity of the shock surpassed the highest degree (10) of the Mercalli scale, the destruction of houses being as complete as at Messina in 1908 and Avezzano in 1915. The epicentre of this earthquake is in 43° 28·2′ N. lat., 12° 7·7′ E. long.,

and it is evident that the focus was at a slight depth. Among the after-shocks was one of less, but still ruinous, intensity, which occurred on April 27 at 2.30 p.m. (G.M.T.).

MR. R. M. DEELEY has sent us a copy of a paper contributed by him to the *Philosophical Magazine* for March, 1918, in which he discusses the temperature distribution in a cyclonic depression, and puts forward a hypothesis as to the causation of these depressions. Upper-air research by means of sounding balloons has shown that in the troposphere the core of a cyclone is cold relatively to the surrounding air, whereas at greater heights, in the stratosphere, the reverse is the case, the air being relatively warm. It is suggested that this warmth probably extends to the confines of the atmosphere. The author considers that the air which flows spirally inwards in the lower layers rises in the central region of the cyclone to great heights, flowing outwards in the higher levels of the stratosphere. This circulation being postulated, it remains to find some means by which the column of rising air in the stratosphere may be warmed, and this Mr. Deeley ascribes to the action of a pencil of high-velocity cosmic matter which strikes and heats the outer part of the atmosphere in a localised patch. The heating is regarded as being produced rapidly and as dying away slowly. According to this theory, cyclones must travel with the winds of the upper atmosphere, which carry the heated core with them. No attempt is made to explain how a cyclone can persist for days, or even weeks, as it travels over the surface of the earth.

AT a meeting of the Institution of Civil Engineers on March 12 three papers were read on electric welding developments. There are three systems in general use. In "spot" welding the metals to be soldered together are placed in contact and an electric current sent between them. This method is rapid and efficient, and is easily performed by unskilled labour. In "seam" or "line" welding, mechanically driven roller electrodes are used; and in the "carbon-arc" process the metal is melted by means of the electric arc. It was pointed out that electric welding would be particularly helpful in the automobile industry, as crank-shafts, broken or worn teeth of gear-wheels, and gear-cases can rapidly be renovated. In shipbuilding it was stated that electric-arc welding has proved successful for forging, riveting, and caulking. It has been found possible to join thick steel plates by welding more economically than by riveting. Experiments showed that in the case of butt-welds the tensile strength of the joints was from 90 to 95 per cent. of that of the solid plate. In the "carbon-arc" process the carbon rod formerly used has now been replaced by an iron welding pencil, which is found to be far more suitable.

THE March issue of the *Geographical Journal* contains a paper by Mr. E. A. Reeves, the map curator of the Royal Geographical Society, on "A Transformation of the Magnetic Dip Chart." The transformation carried out by Mr. Reeves consists in drawing lines through those places on the earth's surface at which the axis of the dip-needle makes equal angles with the axis of the earth instead of with the horizontal plane through the place of observation. This plan gives more regular lines, which approximate to circles having an axis inclined at 3° to 5° to that of the earth. In a contribution to the discussion on the paper Dr. Chapman pointed out that whatever axis were taken as that from which to measure the inclination of the dip-needle, the curves of equal inclination would approximate to circles about an axis between that chosen and the magnetic axis, so long as the earth approximated to a uniformly magnetised sphere. Dr. Chree also pointed out how closely the earth corresponds with a sphere uniformly magnetised about an axis inclined at 12° to the geographic axis. The paper and discussion point to the desirability of taking as the axis of reference the magnetic rather than the geographic axis of the earth.

"EXPERIMENTS with Clay in its Relation to Piles" was the subject of a paper by Mr. A. S. E. Ackermann read before the Society of Engineers on March 10. The experiments described deal on a small scale with the resistance of clay to penetration by discs, pyramids, and cylinders. In one test a cylinder of clay 2 cm. in diameter and 68 cm. in length, fixed at one end and twisted at the other through $37\frac{1}{2}°$, recovered when released through 32°, which is taken to be a proof of the elasticity of clay. The resistance to penetration (without shock) increases as the water-content diminishes. If $W+w$ is the resistance to penetration and V the volume of penetration, then for pyramids $V=a(W+w)^n$, where n is about 1·5. In the case of discs at critical loads the disc started and continued to sink in the clay, the pressure, taken to be the pressure of fluidity, being on the average 587 grams/cm.^{2}, the water-content being 29 per cent. The general conclusions are:—(1) For tapered bodies the load for a given penetration is proportional to the area of surface of contact; (2) it is much greater the less the percentage of water in the clay; (3) the pressure of fluidity is less when the percentage of water is greater; (4) tapered piles support a greater load than parallel-sided piles; and (5) pointed piles are more efficient than blunt. In the application of these results to practice it must be remembered (apart from the small scale of the tests) that the clay with which an engineer deals is less homogeneous than the puddled clay employed; that piles are driven by impact, which disturbs the earth round the pile; and that the important point is not the resistance when driving, but after a period when the earth is more or less resettled. The tests are, however, interesting to physicists and engineers.

A SUGGESTION was made a few days ago during a sitting of the Coal Commission that if higher wages were to be paid to miners, manufacturers would be driven to America or Sweden to seek the advantages of water-power. The allusion to Sweden is striking testimony to the rapid developments which are now taking place in the hydro-electric installations of that country. *Engineering* has from time to time published particulars of these enterprises (reference has also been made to them in these columns), and in its issue of March 7 it has a long article dealing with the impending extension of hydro-electric power schemes under the auspices of the Royal Swedish Waterfalls Board. A power station is projected in Lapland with a capacity of 192,500 kw., having its source in the chain of lakes, the lowest of which, Storea Lulea, finds an outlet in the River Lule. The river is about 100 miles in length, and debouches into the Gulf of Bothnia, just below the Arctic Circle. Two important falls on the river are the Porjus and the Horsprauget. The former has already been utilised to a considerable extent; the load, so far as three-phase current is concerned, amounts to 15,000 kw., and when certain extensions have been effected will reach double that figure. The Horsprauget project will furnish an additional estimated capacity of 192,500 kw. The falls, of which there are several in series, will be impounded in a single installation by the construction of a high dam, which will have the distinction of being larger than any hitherto constructed in Sweden. It will be 1 kilometre (1100 yards) long and about 40 metres

(130 ft.) above the ground at its highest point. By lowering the water-level two metres, a supply of 5,000,000 cubic metres (say 1,100,000,000 gallons) will be available, which is sufficient to equalise load variations during a period of twenty-four hours. The dam will be designed as a composite structure, with special features to resist ice-pressure, which is, of course, a vital consideration in such high latitudes. The aggregate surface area of all the lakes within the catchment area amounts to about 890 sq. km. (343 sq. miles), and the total catchment area to 9860 sq. km. (3805 sq. miles).

OUR ASTRONOMICAL COLUMN.

VENUS AND JUPITER.—The planets Venus, Jupiter, and Saturn are now finely displayed in the evening sky. Venus is situated in Aries, Jupiter in Gemini, and Saturn in Cancer. To the naked eye a very interesting spectacle will be afforded during the ensuing few weeks by the approach of Jupiter and Venus. At present they are distant about 60° from each other, but this interval is decreasing at the rate of slightly more than 1° each night. This is due to the easterly movement of Venus. It will prove an entertaining incident to watch the gradual approach of the two planets until their conjunction on the night of May 25, when they will be very little more than 2° distant from each other near the time of their setting at about 11.11 p.m.

COMETS OF THE JOVIAN FAMILY.—Schorr's comet (*d* 1918) adds another member to the ever-increasing group of short-period comets. Forty of these objects were previously known, but fewer than half of this number had been fully confirmed by observations of a second return to perihelion. Two orbits have been computed for Schorr's comet which differ in the period assigned, one giving 6·73 years and the other 5·86 years. Definitive elements will, no doubt, be calculated when the comet has passed beyond the range of further observations.

STAR CLUSTERS.—Dr. C. V. L. Charlier has made an investigation of the distances and configuration of clusters (Meddelanden, Lund Observatory, ser. ii., No. 19). Making the simple assumption that distance varies inversely as angular diameter, he finds a grouping of the non-globular clusters strikingly similar to that which he found some years ago for the B stars. This is a satisfactory confirmation of the previously accepted conclusion that the non-globulars are intra-galactic objects. Since the centres of the two systems (non-globulars and B stars) are in the same direction from the sun, it is a reasonable assumption that they are coincident, which enables the scale of the non-globular system (at first left arbitrary) to be determined. A second determination, fairly accordant with the first, is made by assuming the extent of the system in a direction perpendicular to the plane of the galaxy to be the same as that found for the B stars. In the galactic plane the distances range to 5000 L.Y., but the great majority are less than 3000. The greatest co-ordinates perpendicular to the plane are about 1600 L.Y., indicating the usually accepted bun-shaped figure. It is evident that the distances of individual clusters cannot be relied on, but it is interesting to note that the distance of the great double cluster in Perseus comes out as 400 L.Y., which is close to the distance deduced for Nova Persei from the rate of illumination of the surrounding nebula.

Treating the globular clusters in the same way, Dr. Charlier finds a configuration similar to that found by Dr. Shapley, but on the question of scale he is in strong opposition to him, insisting on the intra-galactic situation of the globulars, owing to their concentration in the great star-cloud of Sagittarius, and other features of their grouping. He is thus led to take the absolute magnitude of the brightest cluster stars as about +8, and to assert that the cluster variables are dwarfs, though the Cepheids with their similar light-curves are admittedly giants. Prof. Eddington's researches make it unlikely that stars of small mass could attain a sufficient temperature to have a negative colour-index, such as Dr. Shapley found in many of the cluster stars. However, the results of the latter are of such a startling and far-reaching character that it is all to the good, in the interests of the attainment of truth, that an astronomer of Dr. Charlier's eminence should hold a brief for the other side pending further light on some of the weaker links in Dr. Shapley's chain of reasoning.

WEATHER INFLUENCES ON THE WAR.

PROF. ROBERT DE C. WARD contributes an article on "Weather Controls over the Fighting during the Autumn of 1918" to the *Scientific Monthly* for January. This is the concluding communication of a series which has from time to time been noticed in NATURE, and deals with the weather to the time of the signing of the armistice by Germany. The author states his belief that "as a part of the scientific history of the great war, as full an account as possible should be kept of the meteorological conditions which affected the operations on all the battle-fronts."

The autumn of 1918 is stated to have been "in many respects the most critical season, meteorologically, of any period of equal length during the whole war." It was clear that the Allies were determined to force the defeat of the Germans whilst fighting weather lasted. The Allies, by pushing on, were gaining better ground and more shelter for their armies.

At the commencement of September despatches mentioned the "unprecedented dryness" which for about a week favoured the movements of the Allies, but the second week of September experienced heavy storms, which retarded progress. Throughout the war as autumn advanced the fighting conditions were less favourable, and the Flanders mud had proved an almost insurmountable obstacle. The distribution of the rainfall throughout the year at the Western Front is similar to that over the south-east of England, where the heaviest rains occur in the autumn season, the average rainfall of October being equal to that of February and March combined. Add to these conditions the drop of temperature, which on the Continent is much greater than in the British Isles, and the colder weather brings more snow and slush. The rivers are not uncommonly in flood, and, wherever possible, the enemy caused artificial flood, hampering and impeding the movements of the Allies.

Official despatches laid unusual stress on the unfavourable weather controls of the autumn, but probably much of this was due to the intense anxiety of the Allies to crush the enemy before winter set in. All bad weather was helping the enemy by delaying attack and enabling him to organise his retreat. The Monthly Weather Report of the Meteorological Office for September shows that the month was abnormally wet and very cold, whilst in many parts of England "the rainfall totals were the greatest ever measured, not only in September, but in any calendar month whatever." The map showing the movements of

depressions over the British Isles and the adjacent parts of the Continent indicates a north-easterly track for the storm areas, and the Western Front appears to have escaped the passage of the storm centres. October was "dull, damp, and sunless." The rainfall was moderate, but the number of rain-days was excessive over the British Isles. Similarly, unsettled weather was, without doubt, experienced over Flanders. Notwithstanding almost incessant adverse weather controls, "there runs the splendid story of the advance of the Allied troops . . . one despatch (September 12) mentioned the pouring rains which forced the Allied airmen to cease their punishment of the Germans." The stormy and wet weather also greatly handicapped the activity of the Tanks. In the latter part of the autumn, and especially just prior to the armistice, fog was very prevalent, but it did not always prove adverse to the advance of the Allies, although at times it aided the retreating enemy. Short dry and fine spells intervening were very favourable controls, aiding the advance of the Allies in every way.

There was little activity on the Italian Front until late in October, and Prof. Ward states that "the reason for beginning the offensive at that time was doubtless to be sought in the political condition of Austria-Hungary." Military operations on this front ended on November 4.

In Palestine and Mesopotamia the co-ordinated movements of the Allied forces in the autumn led to the defeat of the Turkish armies, and Turkey was driven to surrender.

It would be a valuable scientific asset to have the "Weather Controls" by the author throughout the war brought together and published collectively.

C. H.

THE UNITED STATES NATIONAL MUSEUM.[1]

THE volume before us—the last report submitted by the late Dr. Rathbun as assistant secretary of the United States National Museum—contains no general observations of a striking character, but recounts a large amount of valuable work. There is a long list of accessions, but the numbers have not been summarised. From among them it is not easy to make a selection, but the following seem to be of superior importance:—The Julius Hurter bequest of 3575 reptiles and batrachians, comprising the material for Mr. Hurter's "Herpetology of Missouri" (1911), as well as many genera and species new to the museum; all are good specimens, and beautifully prepared. The Biltmore herbarium, or so much of it as was saved from the flood of July, 1916, presented by the widow of its founder, the late George W. Vanderbilt; the 25,000 specimens saved include many types of Cratægus species. The private collection of cryptogams formed and presented by Prof. O. F. Cook, and numbering about 15,000 specimens. The fine collection of meteorites brought together by Dr. Charles U. Shepard, and bequeathed by his son; it represents 238 falls and finds, some of exceptional interest. Dr. Shepard's extensive collection of minerals and gems remains on deposit in the museum, which is a conditional legatee.

As Dr. Rathbun most truthfully says in his introduction, "the importance of public collections rests, not upon the number of specimens, but upon the use to which they are put." On the educational side the United States National Museum pays great attention to the adequate selection, mounting, and labelling of objects. Of late it has done a good deal by way of models. We read here of a model showing the geology of a coral island, beside which has been erected a real fossil coral reef obtained from the Carboniferous rocks of Kentucky. In the court containing the wood collection are two new models of diverse character. One is part of a national forest, on a scale of 1/300, and measuring 12 ft. by 15 ft., designed to show the various uses of such forests and their administration. The other illustrates a modern plant for the preservative treatment of railway timber. Another model, 16 ft. by 19 ft., reproduces the works of the Bingham Cañon Copper Property, where lean copper ore of the disseminated type is now being worked at a profit. Other models illustrate the manufacture of white lead, and the mode of occurrence, recovery, and preparation of tin, sulphur, asphalt, lime, and oil. These latter, with their associated exhibits, eighteen in all, have been planned to convey an understanding of the various industries based on the mineral resources of the country. Others are in preparation, and explanatory bulletins are being widely distributed.

Another valuable series of exhibits peculiar to this museum is the collection illustrating the history of photography from the earliest times. We allude to this here because the report records the death of Mr. Thomas W. Smillie, who since 1871 had been the museum photographer. The enormous advantage to the educational and research work of a museum in having, not merely a photographic laboratory, but also a trained man of science at its head, can be but dimly apprehended by museum-workers in this country, so far are they from any approach to this.

This leads us to the second great use of the collections—namely, as the basis of research. The report contains, in thirty-seven double-columned pages, a "classified list of papers based wholly or in part on the national collections." A useful feature is the *précis* attached to many of the entries. In the account of work done we are glad to note the friendly co-operation between the National Museum of the United States and that of this country, as exemplified in Mr. Oldfield Thomas's study of the South American mammals.

Any comparison of the scientific output of these two museums would be a difficult matter, but we cannot refrain from noting that the purely natural history staff at Washington numbers fifty-two (exclusive of associates and honorary helpers), whereas that at our Natural History Museum is only forty-two.

THE PROBLEM OF RADIO-ACTIVE LEAD.[1]

I.

WE meet to-day with happiness which six months ago would have seemed beyond the bounds of reasonable hope. After anxious months the confidently awaited victory, which last spring still seemed far away, has crowned the cause of justice, truth, and liberty. We in America rejoice that this cause is our cause, and that at the most critical time we were able to render effective help to the staunch and brave Allied forces which had fought so long and so nobly.

The object of this address is not, however, to appraise the military issues of the great war so fortunately ending, or to deal with the weighty international problems now faced by the world, but rather to bring before you other considerations, having to do with the advancement of science.

[1] Report on the Progress and Condition of the United States National Museum for the Year ending June 30, 1917. Pp. 184. (Washington: Smithsonian Institution, 1918.)

[1] Presidential address to the American Association for the Advancement of Science, Baltimore, December, 1918, by Prof. Theodore W. Richards.

The particular subject chosen, namely, the problem of radio-active lead, is one of peculiar and extraordinary interest, because it involves a readjustment and enlargement of many rather firmly fixed ideas concerning the chemical elements and their mutual relations, as well as the nature of atoms.

Within the last twenty years the definition of these two words, "elements" and "atoms," has been rendered somewhat uncertain, and bids fair to suffer even further change. Both of them are ancient words, and both even a century since had acquired meanings different from those of long ago. Thales thought of but one element, and Aristotle's elements—earth, air, fire, water, and the quintessence, derived perhaps from yet more ancient philosophy—were not plentiful enough to account for all the manifold phenomena of Nature. Democritus's old idea of the atom was associated with the philosophical conception of indivisibility rather than with the idea of chemical combination in definite proportions. To-day many chemists and physicists think that the chemical atoms of the last century are no longer to be considered as indivisible. In that case, the old Greek name "atom" is no longer fitting, because it denotes indivisibility. Someone has even facetiously suggested that the word "tom"—indicating divisibility—would be more appropriate! Moreover, if our so-called atoms are really divisible, we cannot but be somewhat doubtful as to our definition of the ultimate elements of the universe. The reason for this new turn of thought is due, as you all know, to the discovery of the unexpected and startling phenomena of radio-activity.

To-night we have to deal with a substance directly concerned with the iconoclastic radio-active changes—with the very phenomena which cause us to stop and think about our definitions of atoms and elements. For the lead obtained from radio-active minerals appears to have resulted, together with helium, from the radio-active decomposition of elements of higher atomic weight. Sceptical at first, the whole chemical world has now come to acknowledge that the well-defined element helium (discovered by Sir William Ramsay twenty-three years ago) is one of the decomposition products of radium. Radium itself is a substance which, in many respects, acts as an element, with 226 as its atomic weight, and must be considered as the heaviest member of the well-known calcium family; but its atoms appear to be so big and so complex as to disintegrate because of lack of stability. The disintegration is slow, and not to be hastened or retarded by any agency known to man; 1670 years are demanded for the decomposition of half of any given portion of radium, according to the exact measurements of Profs. Boltwood and Ellen Gleditsch. Moreover, we have reason to believe that this decomposition proceeds in a series of stages, successive atoms of helium (five in all) being evolved with different degrees of ease by any given atom of radium. In the end most—indeed, probably all—of the residual part of the radium appears to have been converted into the peculiar kind of metallic lead with which we are concerned to-night. The nature of the end-product was first suggested by Boltwood, who pointed out the invariable presence of lead in radium minerals. Thus we must accept a kind of limited transmutation of the elements, although not of the immediately profitable type sought by the ancient alchemists.

Interesting and significant as all this is, nevertheless the whole story has not yet been told. Radium itself appears to come from the exceedingly slow decomposition of uranium, an inference drawn from the fact that radium is found only in conjunction with the uranium, which, even after careful purification, soon becomes radio-active, and gives every indication of suffering slow disintegration. Moreover, uranium is not the only other heavy element which appears to be capable of decomposing and yielding elements of lower atomic weight. Another, thorium, has a like propensity, although the steps in this case are perhaps not so fully interpreted, or so generally accepted. In the process of disintegration all these heavy atoms yield strange radiations, some of them akin to, or identical with, X-rays, which bear away that part of the colossal energy of disintegration not made manifest as heat. These facts have been proved beyond doubt by the brilliant work of Mme. Curie, Sir Ernest Rutherford, and others.

The nature of the rays and of the highly interesting evanescent transition products and their relation to one another are too complex for discussion now. We are concerned rather with the nature of the more permanent of the substances concerned, especially with the starting point, uranium (possessing the heaviest of all atoms), radium, and the lead which seems to result from their disintegration. Omitting the less stable transition products, the most essential outcomes are roughly indicated by a sort of genealogical tree herewith shown:—

Hypothesis Concerning the Disintegration of Uranium.

$$\left.\begin{array}{l} \text{Uranium} \\ \downarrow \quad \searrow 3 \text{ Helium} \\ \text{Radium} \\ \downarrow \quad \searrow 1 \text{ Helium} \\ \text{Emanation} \\ \downarrow \quad \searrow 4 \text{ Helium} \\ \text{Lead (Isotopic)} \end{array}\right\} 8 \text{ Helium}$$

Thus each atom of uranium is supposed to be converted into radium by losing three atoms of helium, and each atom of radium is supposed to be converted into a kind of lead by losing five more, as already stated.

If uranium can thus disintegrate, should we call it an element? And should we call its smallest particles atoms? The answers depend upon our definition of these two words. If the word "element" is supposed to designate a substance incapable of disintegration, apparently it should not be applied to uranium; neither should the word "atom" be applied to the smallest conceivable particles of this substance. But no one would now maintain that any element is really incapable of disintegration. A method of still retaining the terms in this and analogous cases is to define an element as "a substance which has not yet been decomposed artificially"—that is to say, by the hand of man; and an atom as "the smallest particle of such a substance, inferred from physico-chemical behaviour." The atom, then, is not to be considered as wholly indivisible, but only as indivisible (or, at least, as not yet divided) by artificial means. For, as in the case of radium, the disintegration of uranium cannot be hastened or retarded by any known earthly agency. So long as it stays intact, the atom of uranium behaves quantitatively in the same fashion as any other atom; Dalton's laws of definite and multiple combining proportions apply without exception to its compounds. In this connection one should remember that the atomic theory as a whole, including Dalton's and Avogadro's generalisations, is not in the least invalidated by the new discoveries of radio-activity. On the contrary, the atomic theory is entrenched to-day more firmly than ever before in its history.

Interesting speculations by Drs. Russell, Fleck, Soddy, Fajans, and others have interpreted in extremely ingenious and plausible fashion the several transitory steps of the changes, and indicate the reasons why the end-products of the decomposition of both uranium and thorium should be very similar

to lead, if not identical with it. Therefore, a careful study of the properties of lead of indubitably radioactive origin became a matter of great interest, as a step towards confirming these speculations, especially in comparison with the properties of ordinary lead. Such investigations should throw light on the nature of radium and uranium and the extraordinary changes which those metals suffer. Moreover, by analogy, the resulting conclusions might be more or less applicable to the relations of other elements to each other; and the comparison of this new kind of lead with ordinary lead might afford important information as to the essential attributes of elementary substances in general, in case any differences between the two kinds should be found.

Before the subject had been taken up at Harvard University chemists had already recognised the fact that the so-called uranium-lead is indeed qualitatively very like ordinary lead. It yields a black sulphide, a yellow chromate, and a white sulphate, all very sparingly soluble in water, just as ordinary lead does. Continued fractional crystallisation or precipitation had been shown by Prof. Soddy and others to separate no foreign substance. Hence great similarity was proved, but this does not signify identity. Identity is to be established only by quantitative researches. Plato recognised long ago, in an oft-quoted epigram, that when weights and measures are left out, little remains of any art. Modern science echoes this dictum in its insistence on quantitative data; science becomes more scientific as it becomes more exactly quantitative.

One of the most striking and significant of the quantitative properties of an element is its atomic weight—a number computed from the proportion by weight in which it combines with some other element, taken as a standard. There is no need, before this distinguished audience, of emphasising the importance of the familiar table of atomic weights; but a few parenthetical words about their character is, perhaps, not out of place. As has been said more than once, the atomic weights of the relatively permanent elements, which constitute almost all the crust of the earth, seem to be concerned with the ultimate nature of things, and must have been fixed at the very beginning of the universe, if, indeed, the universe ever had any beginning. They are silent, apparently unchanging, witnesses of the transition from the imagined chaos of old philosophy to the existing cosmos. The crystal of quartz in a newly hewn piece of granite seems, and probably is, as compact and perfect as it was just after it was formed æons ago. We cannot imagine that any of its properties have essentially changed during its protracted imprisonment; and, so far as we can guess, the silicon and oxygen of which it was made may have existed for previous æons, first as gas, and then as liquid. The relative weights in which these two elements combine must date at least from the inconceivably distant time when the earth was "without form and void."

Although, apparently, these numbers were thus determined at the birth of our universe, they are, philosophically speaking, in a different class from the purely mathematical constants such as the relation of circumference to the diameter of a circle. 3·14159... is a geometrical magnitude entirely independent of any kind of material, and it therefore belongs to the more general class of numbers, together with simple numerical relations, logarithmic and trigonometric quantities, and other mathematical functions. On the other hand, the atomic weights of the primeval elements, although less general than these, are much more general and fundamental than the constants of astronomy, such as the so-called constant of gravity, the length of the day and year, the proper motion of the sun, and all the other incommensurable magnitudes which have been more or less accidentally ordained in the cosmic system. The physico-chemical constants, such as the atomic weights, lie in a group between the mathematical constants and the astronomical "constants," and their values have a significance only less important than the former.

In the lead from uranium we have a comparatively youthful elementary substance which seems to have been formed since the rocks in which it occurs had crystallised. Is the atomic weight of this youthful lead identical with that of the far more ancient common lead, which seems to be more nearly contemporary as to its origin with the silicon and oxygen of quartz?

The idea that different specimens of a given element might have different atomic weights is by no means new; it far antedates the discovery of radio-activity.

Ever since the discovery of the definite combining proportions of the elements and the ascription of these proportions to the relative weights of the atoms, the complete constancy of the atomic weights has occasionally been questioned. More than once in the past investigators have found apparent differences in the weights of atoms of a single kind, but until very recently all these irregularities have been proved to be due to inaccurate experimentation. Nevertheless, even thirty years ago the question seemed to me not definitively answered, and careful experiments were made with copper, silver, and sodium, obtained from widely different sources, in the hope of finding differences in the atomic weights, according to the source of the material. No such differences whatever were found. More recently Prof. Baxter compared the atomic weights of iron and nickel in meteorites (from an unknown, perhaps inconceivably distant, source) and the same terrestrial metals. In these cases also the results were negative. Thus copper, silver, sodium, iron, and nickel all appeared to be perfectly definite in nature, and their atoms, each after its own kind, all alike.

The general question remained, nevertheless, one of profound interest to the theoretical chemist, because it involved the very nature of the elements themselves; and in its relation to the possible discovery of a difference between uranium-lead and ordinary lead it became a very crucial question.

Early in 1913, when the hypothesis of radio-active disintegration had assumed definite shape, Dr. Fajans's assistant, Max Lembert, journeyed to Cambridge, Mass., bringing a large quantity of lead from Bohemian radio-active sources in order that its atomic weight might be determined by Harvard methods, with the precision attainable there. The Carnegie Institution of Washington gave generous pecuniary assistance towards providing the necessary apparatus in this and later investigations.

The most important precautions to be taken in such work are worthy of brief notice, because the value of the results inevitably depends upon them. The operation consists in weighing specimens of a salt of the element in question, and then precipitating one of the constituents in each specimen, determining the weight of the precipitate, and thus the composition of the salt. In the first place, each portion of substance to be weighed must be free from the suspicion of containing unheeded impurities, otherwise its weight will mean little. This is an end not easily attained, for liquids often attack their containing vessels and absorb gases, crystals include and occlude solvents, precipitates carry down polluting impurities,

dried substances cling to water, and solids, even at high temperatures, often fail to discharge their imprisoned contaminations. Especial care was taken that each specimen was as pure as it could be made, for impurity in one would vitiate the whole comparison.

In the next place, after an analysis has once begun, every trace of each substance to be weighed must be collected and find its way in due course to the scale-pan. The trouble here lies in the difficulty in estimating, or even detecting, minute traces of substances remaining in solution, or minute losses by evaporation at high temperatures.

In brief, "the whole truth and nothing but the truth" is the aim. The chemical side of the question is far more intricate and uncertain than the physical operation of weighing. The real difficulties precede the introduction of the substance into the balance-case. Every substance must be assumed to be impure, every reaction to be incomplete, every measurement to contain error, until proof to the contrary can be obtained. Only by means of the utmost care, applied with ever-watchful judgment, may the unexpected snares which always lurk in complicated processes be detected and rendered powerless for evil.

After all these digressions, made in order that the problems concerned should be clearly recognised, let us turn to the main object of our quest. In the present case each form of lead was first weighed as pure chloride, and the chlorine in this salt after solution was precipitated as silver chloride, the weight of which was determined. Precautions too numerous to mention were observed. Thus the weight of chlorine in the salt was found, and by difference the weight of the lead. From the ratio of weights the atomic weight of lead was easily calculated.

The outcome of the first Harvard trials, published in July, 1914, brought convincing evidence that the atomic weight of the specimen of uranium-lead from Bohemia is really less than that of ordinary lead, the value found being 206·6 instead of 207·2—a difference of 0·3 per cent., far beyond the probable error of experiment. Almost simultaneously preliminary figures were made public by Drs. Hönigschmid and St. Horovitz and by Maurice Curie, pointing towards the same verdict.

This result, interesting and convincing as it was, was only a beginning. Other experimenters abroad have since confirmed it, especially Prof. Hönigschmid, who had studied at Harvard and understood the necessary refinements of analysis; and many new determinations have been made at the Wolcott Gibbs Memorial Laboratory, with the assistance of Dr. Charles Wadsworth and Dr. Norris F. Hall, upon various samples of lead from radio-active sources in widely separated parts of the world. Messrs. E. R. Bubb and S. Radcliff, of the Radium Hill Co., of New South Wales, kindly sent a large quantity of lead from their radium mines, and a particularly valuable specimen prepared from selected crystals of pure mineral was put at our disposal by Prof. Gleditsch—not to mention other important contributions from others, including Prof. Boltwood and Sir William Ramsay. Each of these samples gave a different atomic weight for the lead obtained from them, and the conclusion was highly probable that they contained varying admixtures of ordinary lead in the uranium-radium-lead. This was verified by the knowledge that in at least some cases the uranium ore actually had been contaminated with lead ore. The purest Norwegian specimen thus acquired especial importance and significance, because it was only very slightly, if at all, vitiated in this way. As a matter of fact, it gave 206·08 for the atomic weight in question—the lowest of all. Here are typical results, showing the outcome; many more of similar tenor were obtained:—

Atomic Weights.

Common lead	207·20 207·19	207·19
Australian radio-active lead containing probably 25 per cent. ordinary lead ...	206·32 206·36 206·33 206·36	206·34
Purest uranic-lead	206·08 206·09	206·08

Hönigschmid, from similar pure material, had found figures (206·05) agreeing almost exactly with the last value. One cannot help believing that this last specimen of lead is a definite substance, probably in a state almost pure, because of the unmixed quality of the carefully selected mineral from which it was obtained.

A further question now arises: Is it a *permanent* substance—really an end-product of the disintegration? Soddy's hypothesis assumes that it is. The only important fact militating against this view is the observation that uranium-lead is always radio-active, and hence might be suspected of being unstable. In various impure specimens, however, the radio-activity is not proportional to the change in the atomic weight; hence the radio-activity is probably, at least in part, to be referred, not to the lead itself, but rather to contamination with minute, unweighable amounts of intensely radio-active impurities—other more transitory products of disintegration.[2] If weighable, such impurities would almost certainly *increase*, not *diminish*, the atomic weight; hence their presence could not account for the low value.

Let us compare the actual result for the atomic weight of this kind of lead with the theory of Soddy and Fajans. If this theory is sound, the simple subtraction of eight times the atomic weight of helium from that of uranium, or five times the atomic weight of helium from that of radium, should give the atomic weight of the lead resulting from the disintegration as follows:—

Hypothetical Calculation of Atomic Weight of Uranium-lead.

Atomic weight of uranium	=238·18	
8 × atomic weight of helium	= 32·00	
Residue (lead?)	206·18	=206·18
Atomic weight of radium	=225·96	
5 × atomic weight of helium	= 20·00	
Residue (lead?)	205·96	=205·96
Average hypothetical value for lead... ...		=206·07
Observed value for uranium-lead[3]		=206·08
Difference		0·01

The agreement is remarkably good. Each of the individual calculated values shows less than 0·05 per cent. deviation from the average, and the average itself shows essential identity with fact—a striking confirmation of the theory. This is, perhaps, the most successful attempt on record to compute an atomic weight from hypothetical assumptions. Usually we are wholly at a loss as to the theory underlying the precise relationships, and must determine our values by careful experiment alone.

[2] For this reason the term "radio-active lead," although it describes the fact, is from a theoretical point of view perhaps not the best designation of either uranium- or thorium-lead; but the term is convenient, because it distinguishes between these two forms and common lead.

[3] This is the Harvard result. If Hönigschmid's value is given equal weight, the average observed value would be 206·07, exactly identical with the hypothetical value.

The value 206·08 for the atomic weight of lead has further support in the fact that it is more nearly half-way between thallium, 204, and bismuth, 208, the two neighbouring elements in the periodic system, than is the atomic weight 207·2 possessed by ordinary lead.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. C. E. Inglis, fellow of King's, has been elected professor of mechanism and applied mechanics in succession to the late Prof. Bertram Hopkinson.

EDINBURGH.—A gift of 10,000*l.* from a donor who desires to remain anonymous has been presented to further progress in the study and teaching of some subject related to surgery by endowing a lectureship in orthopædics.

An offer of 15,000*l.* for the foundation of a chair in accounting and business method has been made by the following public bodies:—Edinburgh Chamber of Commerce, the Edinburgh Merchant Company, Leith Chamber of Commerce, Leith Shipowners' Society, the Society of Accountants in Edinburgh, and the Institute of Bankers in Scotland. A draft ordinance for the foundation of this chair was submitted along with other draft ordinances for the foundation of chairs in psychiatry, forestry, and zoology.

A proposal to purchase a site for the extension of the University has been approved.

Dr. A. E. Sprague has been appointed University lecturer in actuarial science.

Mr. A. S. Stenhouse and Major Walter Bisset have presented to the Geology Department valuable collections of minerals, rocks, and fossils.

NOTTINGHAM.—Prof. A. W. Kirkaldy, of Birmingham University, has been appointed professor of economics and commerce at University College in succession to Prof. J. A. Todd, who has accepted a position under the Board of Trade.

OXFORD.—Two important professorships are at present vacant in the University, and in each case the electors intend to proceed to an election in Easter week. These are the professorship of experimental philosophy and Dr. Lee's professorship of chemistry. The stipend attached to each chair is 900*l.* a year. Candidates are requested to send in their applications, with such evidence of their qualifications as they may desire to submit, to the Registrar of the University, University Registry, Oxford, so as to reach him not later than March 31. *Ten* copies of the letter of application, and of any testimonials submitted, should be sent. The duty of the professor of experimental philosophy, who will have charge of the Clarendon laboratory, will be to give instruction chiefly on mechanics, sound, light, and heat. That of Dr. Lee's professor of chemistry will be to give instruction chiefly in inorganic and physical chemistry.

The numbers of undergraduates during the term just past have been about half the usual strength. It is expected that the normal numbers will be reached, and perhaps exceeded, in the term that begins on April 25.

DR. H. PRINGLE, chief assistant to the professor of physiology and lecturer in histology in the University of Edinburgh, has been elected King's professor of the Institutes of Medicine in the School of Physic in Ireland.

THE New York correspondent of the *Times* announces that Yale and Princeton Universities have decided to abolish the principle of compulsory Latin in the curriculum. It will now be possible to obtain any degree without that language, with the exception of the arts degree at Princeton. At all other examinations the candidates will be permitted to offer a modern language instead of Latin. Princeton will also abolish compulsory Greek in the examination for an arts degree.

ON March 19 Mr. Fisher, President of the Board of Education, delivered a lecture arranged by the Industrial Reconstruction Council on "The Functions of Government in Relation to Education." During the course of his remarks Mr. Fisher said that in the near future it may be found possible to increase Treasury grants to the universities and to extend encouragement to scientific research in all fruitful directions. We have now reached a point in educational development at which it is clear that the universities will be compelled to accept a larger measure of State assistance than has hitherto been afforded to them to meet the needs in certain important branches of scientific development. For instance, trained meteorologists are needed for aviation purposes, trained marine physicists in connection with submarines, and hydraulic engineers for the proper use of our waterways. What is the solution to the many problems which present themselves? Mr. Fisher has come to the conclusion that it partly depends upon the intelligent co-operation of the universities themselves, but partly that intelligent co-operation must be assisted by the gentle and indirect pressure exercised by the distribution of Treasury grants to the universities willing to receive them; and he intends, in collaboration with the Secretary for Scotland and the Chief Secretary for Ireland, to set up a Committee which will distribute grants to universities in the administration of which there will be some opportunity to give counsel to the universities as to a particular line of development in the pursuit of which they are most likely to contribute to the common weal.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 13.—Sir J. J. Thomson, president, in the chair.—Dr. A. D. **Waller**: Concerning emotive phenomena. Part iii.: The influence of drugs upon the electrical conductivity of the palm of the hand.—Dr. W. L. **Balls**: The existence of daily growth-rings in the cell-wall of cotton hairs. The probability that such growth-rings existed had been formerly deduced from studies upon the physiology and environment of the cotton-plant in Egypt; but, since their thickness must be sub-microscopic, direct evidence was unobtainable until recently. By swelling the wall in hydration following formation of cellulose xanthate, by counting the layers thus magnified in thickness, and by comparative studies on the fuzz-hairs, it is shown that each such ring corresponds with the cellulose laid down during one night's growth. The existence of variation as to kind or texture of cellulose thus shown to exist within the thickness of the wall, repeated some twenty-five times in the adult hair, necessitates reconsideration of many chemical and physical aspects of cellulose problems.

Geological Society, March 12.—Mr. G. W. Lamplugh, president, in the chair.—Lieut. E. H. **Pascoe**: The early history of the Indus, Brahmaputra, and Ganges. From geological indications the author concludes that the first effect of the commencement of the Himalayan uplift was the establishment of a great westward-flowing river along the southern face of the range, for which he proposes the name of Indobrahm. The

distribution of Tertiary rocks on the northern side of the range suggests that here also a westward-flowing river was formed, which either discharged round the end of the range into the same sea as the Indobrahm, or flowed westwards into the region of Turkestan and the Caspian Sea. The later history of the drainage system consists of the capture of the upper waters of this river by a tributary of the Indobrahm, a cutting-back along the valley to form the eastward-flowing Tsangpo, now the upper waters of the Brahmaputra, and the capture of the lower reaches in part by the Sutlej and in part by the Attock tributary of the Indobrahm, to form the Himalayan portion of the Indus valley. Meanwhile, on the southern side of the range, some of the tributaries on the eastern side of the Lower Indobrahm had cut back from the Sind region and cut off the original bend near Attock, to form the present plains of the Punjab; and farther east a river cutting back along the present line of the Gangetic delta and lower course of the Ganges and Brahmaputra had captured the upper waters of the Indobrahm to form the present Brahmaputra. The same system of capture had worked westwards, until the tributaries of the Indobrahm had been successively diverted from a westerly to an easterly drainage up to and including the Jumna River.—Dr. A. Smith **Woodward**: Fish-remains from the Upper Devonian (Pickwell-Down Sandstones) of Woolacombe Bay (North Devon). The remains were discovered by Mr. Inkerman Rogers, and noticed by him in the *Geological Magazine* for March, 1919.

Royal Meteorological Society, March 19.—Sir Napier Shaw, president, in the chair.—Prof. L. **Hill**: Atmospheric conditions which affect health. Numerous observers make records of barometric pressure, temperature, rainfall, wind, etc., but the question arises as to whether there are not other data of greater importance and interest which affect personal health and comfort, and might be recorded. In the past much has been made of the chemical alteration of the air in crowded places, and unsound views have become popular. The victims of the Black Hole of Calcutta died from heat-stroke, not from a poisonous vitiation of the air by the exhalations of the crowd. It is the cooling and evaporative power of the atmosphere and the radiant heat of the sun, or other source of radiant energy, which affect our comfort and well-being, and it is these factors which require to be measured by the student of hygiene. The dry-bulb temperature does not suffice to indicate the cooling effect, because it is a static instrument averaging the influence of the environment, while the body is a dynamic instrument keeping itself at a nearly constant body-temperature by the internal combustion of food and by heat loss from the skin and respiratory membrane, the heat gain and loss both being physiologically controlled. It is cooling power acting on the body-surface, not temperature, which we require to study; and as the surface of the respiratory membrane is always wet, and the skin may be made relatively dry or very wet by physiological control, evaporative cooling is of no less importance than cooling by convection and radiation. To estimate cooling power the author has introduced the kata-thermometer.

PARIS.

Academy of Sciences, March 3.—M. Léon Guignard in the chair.—M. **Hamy**: The study of the perturbations of the optical axis of a meridian telescope. An arrangement of two doubly reflecting prisms is described, which permits the total value of the errors due to the imperfections of the telescope to be determined.—A. **Rateau**: The successive states of a gas at high pressure in a receptacle which is emptied by a jet.—A. **Blondel**: The free oscillations of alternators on a network at constant pressure.—E. **Ariès**: The application to eight different substances of the formula which expresses the heat of evaporation of a liquid. The substances chosen are carbon dioxide, ammonia, stannic chloride, methyl formate, and pentane and its three next higher homologues. A table is given showing the agreement between the calculated and published experimental values.—Louis Fabry was elected a correspondant for the section of astronomy in succession to the late M. Backlund.—R. **Garnier**: The irregular singularities of linear differential equations.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the fourth quarter of 1918. The observations made on sixty-seven days during this quarter are grouped in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—L. **Dunoyer** and G. **Reboul**: The prediction of barometric variations.—G. **Guilbert**: The anomalies of the meteorological station of Skudesness (Norway). The station of Skudesness is the only meteorological station in Europe where the known laws governing the direction and force of surface winds are frequently found to fail. The author suggests that the abnormal winds at this station reveal the existence of very distant cyclonic disturbances, situated west of the British Isles and showing no indication here. On certain days the data from the Skudesness station alone can be used to predict the arrival of a storm.—D. **Faucher**: Contribution to the determination of the lacustral levels of the lower valley of the Vardar.—S. **Stéfanescu**: The transversal sections of the plates of molars.—Mme. Dolorès **Cebrian de Besteiro** and M. **Michel-Durand**: The influence of light on the absorption of organic material of the soil by plants. It has been previously shown that the pea cannot adapt its chlorophyll assimilation to feeble illumination. It is now found to be equally incapable of increasing the absorptive power of its roots in such a manner as to extract from the soil a larger quantity of organic carbon.—J. **Eriksson**: Biological and systematic studies on the Swedish Gymnosporangium.—F. **Maignon**: Study of the mechanism of the action of fats in the utilisation and assimilation of albuminoids. It has been shown in preceding communications that fats exert a double influence on the albuminoids of food; they diminish their toxicity and increase their nutritive power. The view is put forward that the fatty acids arising from the fats can combine with the amino-acid nucleus of a protein, thus leading to the formation of specific albumens. The author does not regard the view put forward by Crevat, J. Kuhn, and others that fats favour the digestion of albuminoids by stimulating the secretion of digestive juices as sufficient.—A. **Paillot**: Parasitic coccobacilli of the caterpillars of *Pieris brassicae*. During the great invasion in 1917 by *P. brassicae* opportunity was taken to isolate a certain number of parasitic micro-organisms. Details of five new species are given.

BOOKS RECEIVED.

Manual of Vegetable-garden Insects. By C. R. Crosby and M. D. Leonard. Pp. xv+391. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) 12s. 6d. net.

Fermat's Last Theorem: Three Proofs by Elementary Algebra. By M. Cashmore. Revised edition. Pp. 55. (London: G. Bell and Sons, Ltd.) 2s. 6d. net.

Army Gardens in France, Belgium, and Occupied German Territory. Their Making and Management, with Plans and Directions Suited to the Garden Service of the British and American Expeditionary Forces.

By Georges Truffaut, with the collaboration of Helen Colt. Pp. 65. (Versailles: Œuvre des Pépinières Nationales du Touring-Club de France, 1919.)

Botany: A Text-book for Senior Students. By D. Thoday. Second edition. Pp. xix+524. (Cambridge: At the University Press, 1919.) 7s. 6d. net.

The Principles of Mental Hygiene. By Dr. William A. White. With an Introduction by Dr. S. E. Jelliffe. Pp. xiv+323. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) 10s. 6d. net.

Eléments de Botanique. Par Prof. Ph. Van Tieghem. Cinquième Edition. Par Prof. J. Costantin. Tome i.: Botanique Générale. Pp. xv+619. Tome ii.: Botanique Spéciale. Pp. xx+743. (Paris: Masson et Cie, 1918.) 14 francs.

The New Physiology and Other Addresses. By Dr. J. S. Haldane. Pp. vii+156. (London: Charles Griffin and Co., Ltd., 1919.) 8s. 6d. net.

Conscience and Fanaticism: An Essay on Moral Values. By George Pitt-Rivers. Pp. xvi+112. (London: William Heinemann, 1919.) 6s. net.

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Formulaire de l'Électricien et du Mécanicien. Par Hospitalier et Roux. Vingt-neuvième édition par Gaston Roux. Pp. ii+1485. (Paris: Masson et Cie, 1919.) 20 francs.

My House in the World: Essays in Quiet. By James Guthrie. Pp. 160, with ten drawings by the author. (London: Heath, Cranton, Ltd., n.d.) 5s. net.

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Education: Secondary and University. A Report of Conferences between the Council for Humanistic Studies and the Conjoint Board of Scientific Societies. By Sir Frederic G. Kenyon. Pp. 47. (London: John Murray, 1919.) 1s. net.

A System of Physical Chemistry. By Prof. W. C. McC. Lewis. Second edition. In three volumes. Vol. iii.: Quantum Theory. With two appendices by James Rice. (Text-books of Physical Chemistry.) Pp. viii+209. (London: Longmans, Green, and Co., 1919.) 7s. 6d. net.

A Handbook of Colloid Chemistry. The Recognition of Colloids, the Theory of Colloids, and their General Physico-Chemical Properties. By Dr. Wolfgang Ostwald. Second English edition. Translated from the third German edition by Prof. Martin H. Fischer. With numerous notes added by Emil Hatschek. Pp. xvi+284. (London: J. and A. Churchill, 1919.) 15s. net.

Molecular Physics. By Dr. J. A. Crowther. Second edition. (Text-books of Chemical Research and Engineering.) Pp. viii+190. (London: J. and A. Churchill, 1919.) 6s. net.

Golden Days from the Fishing-Log of a Painter in Brittany. By Romilly Fedden. Pp. xviii+233. (London: A. and C. Black, Ltd., 1919.) 7s. 6d. net.

Sir William Turner, K.C.B., F.R.S., Professor of Anatomy and Principal and Vice-Chancellor of the University of Edinburgh. A Chapter in Medical History. By Dr. A. Logan Turner. Pp. xv+514. (Edinburgh and London: William Blackwood and Sons, 1919.) 18s. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 27.

ROYAL INSTITUTION, at 3.—Prof. C. H. Lees: Fire Cracks and the Forces Producing Them.

ROYAL SOCIETY, at 4.30.—H. L. Hawkins: The Morphology and Evolution of the Ambulacrum in the Echinoidea.—Dr. R. McCarrison: The Genesis of Œdema in Beriberi.

CHEMICAL SOCIETY, at 4.30.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—The late H. R. Constantine: The Co-ordination of Research in Works and Laboratories.

FRIDAY, MARCH 28.

PHYSICAL SOCIETY, at 5.—Discussion on Metrology in the Industries. Introduced by Sir R. T. Glazebrook.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting), at 7.—Dr. J. F. Crowley: The Organisation of Technical Engineers.

SATURDAY, MARCH 29.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, MARCH 31.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. H. E. Armstrong: Problems of Food and their Connection with our Economic Policy.

TUESDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: British Ethnology—The People of Scotland.

WEDNESDAY, APRIL 2.

ROYAL SOCIETY OF ARTS, at 4.30.—W. N. Boase: The Cultivation and Preparation of Flax, and the Linen Industry.

THURSDAY, APRIL 3.

ROYAL INSTITUTION, at 3.—Prof. A. Findlay: Colloidal Matter and its Properties.

LINNEAN SOCIETY, at 5.—W. B. Brierley: An Albino Mutant of *Botrytis cinerea*.—Dr. J. D. F. Gilchrist: The Post-Puerulus Stage of *Jasus lalandii*.—Montagu Drummond: The Ecology of a Small Area in Palestine.

CHILD-STUDY SOCIETY, at 6.—Dr. E. Pritchard: Home *v.* Institutional Training of Young Children.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Lt.-Col. A. G. T. Cusins: The Development of Army Wireless during the War.

CHEMICAL SOCIETY, at 8.

SATURDAY, APRIL 5.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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THURSDAY, APRIL 3, 1919.

PRESERVATION OF TIMBER IN INDIA.

The Indian Forest Records. Vol. vi., part iv.: "A Further Note on the Antiseptic Treatment of Timber, recording Results obtained from Past Experiments." By R. S. Pearson. Pp. vi+ii+128+maps and plates. (Calcutta: Superintendent Government Printing, India, 1918.) Price 3 rupees, or 4*s.* 6*d.*

ALTHOUGH the main principles involved in the antiseptic treatment of timber as a means of protecting it against decay induced by fungi are invariable, their precise application is necessarily modified in detail with differences of climate and of the timbers treated. In India an additional factor intervenes in the necessity for the simultaneous protection of wood from attacks by insects, and from termites in particular.

Extremes of climate in India introduce difficulties in the antiseptic protection of timber that are lacking in cold-temperate regions. For instance, as Mr. Pearson notes, in hot, dry Indian districts the highly antiseptic lighter oils of raw creosote evaporate more rapidly than in cooler regions, so that ordinary creosote-oil would appear to be not so well suited for the preservation of railway sleepers in India as in England; accordingly Mr. Pearson, with the support of preliminary trials, rather favours the usage of heavier tar-oils. This relatively rapid loss of the more volatile tar-oils suggests that in India there should be deeper penetration, or possibly injection of larger quantities, of tar-oils when compared with current European practice; yet it is quite possible that the heavier oils remaining in the wood may be more toxic at the higher temperatures in India than in Europe, in which case ordinary creosote-oils might be well suited for use in India.

Depth and evenness of penetration of the antiseptic, and the amount of this injected, may thus acquire increased importance in India. But these details in the impregnation of timber, when pneumatic pressure is employed, are determined not only by the nature and water-contents of the wood, but also by the temperatures at which the process is carried out, by the intensity, duration, and rate of application of the pneumatic pressure, and even by the gas-pressures prevailing in the injection vessel before the admission or after the expulsion of the antiseptic. Only the fringe of this branch of the subject as regards Indian woods has been touched. The modern experiments we owe to Mr. Pearson, who conducted trials under varying conditions on the penetration of green oil mixed with "earth oil" ("liquid fuel") into some dipterocarp and several other timbers. In an earlier paper Mr. Pearson described his experiments on the absorption of antiseptic solutions by a number of Indian timbers treated in hot or cold baths ("open tanks").

Quite apart from any weakening of the antiseptic by evaporation of its components, depth of penetration is of special importance where the climate is hot and dry for prolonged periods and the treated wood is used out of doors—for instance, in the form of railway sleepers. In such places during drought the wood is particularly prone to develop splits, which not only cause mechanical weakness, but also provide points of entry for destructive fungi or insects. Mr. Pearson directs particular attention to this danger of splitting, and to the consequent necessity for seasoning wood to such a degree of dryness as will correspond with the atmospheric humidity. He suggests the possible use of artificial seasoning (kiln-drying) when a considerable degree of dryness has to be attained. In this connection several difficulties call for investigation. It will probably be found that in very dry parts of India the wood is in moisture-equilibrium with the air when it contains as little as 6, or even less, per cent. of water; but under artificial seasoning to such a degree of dryness wood is apt to become brittle. Again, the question arises as to the course to be pursued when the climate includes sharply marked alternating hot dry and wet seasons. Both these difficult cases may perhaps be met more or less efficiently by using a sufficiently deep injection of solutions (say of tar-oils) that obstruct the interchange of moisture between wood and atmosphere, and consequently decrease warping and splitting.

When the climate is permanently or periodically humid, soluble salt solutions, such as zinc chloride, will be washed out of exposed wood even more rapidly than in this country; accordingly, Mr. Pearson tentatively concludes that such preservative salts are unsuitable for use in sleepers in wet Indian climates. It appears possible that the use of zinc chloride to preserve railway sleepers in hot, dry climates may likewise be unsatisfactory; for the dry sleepers, exposed to the direct rays of the sun, will be raised to temperatures that may be sufficiently high to cause the zinc chloride to exercise its directly destructive action on the wood.

It is clear that, in general, but particularly in extreme Indian climates, in selecting an antiseptic solution as a preservative of timber, it is impossible to rely merely upon the fungicidal or insecticidal efficiency of the fresh solution. Only prolonged trials can solve the problems as to the depth of penetration and the amount of solution that yield most satisfactory economic results. The antiseptic most commonly used in England for railway sleepers and paving blocks, "creosote-oil," is costly in India, where its antiseptic durability is also dubious. Accordingly, Mr. Pearson's experiments include trials with solutions ranging from various tar-oils and their derivatives to rock-oils, salt solutions (including zinc chloride and sodium fluoride), and mixtures of these, also a saccharine solution containing arsenic in solution.

To determine all the unknown factors that will form the bases of the technically and commercially most satisfactory methods of preserving various

Indian timbers for divers uses would require years of work conducted by a number of investigators. Mr. Pearson's is pioneer work rather aiming to arrive at some practical conclusions within a time corresponding with the urgency of India's needs. But it would appear eminently desirable to accelerate and extend Mr. Pearson's work by the employment of a staff of investigating experts, in view not only of the results that he has already obtained, but also of the possibility that in India it may often be commercially more profitable to cultivate rapidly growing timber trees the wood of which is perishable and of low quality, but capable of being cheaply preserved by antiseptic treatment, than to grow trees of slower growth the timber of which is superior in quality and in durability. PERCY GROOM.

PROF. RIGHI'S RESEARCHES.

I Fenomeni Elettro-Atomici sotto l'Azione del Magnetismo. By Prof. A. Righi. Pp. xvi+435. (Bologna: Nicola Zanichelli, n.d.) Price 17.50 lire.

IN this volume Prof. Righi gives a summary of his researches on the effect of a magnetic field on the electric discharge. These researches have been mainly concerned with three effects: the change in the potential required to start the discharge, the change in the appearance of the charge at low pressures, and the mechanical forces acting on bodies in the neighbourhood of the discharge. In all three branches of his study he has recorded a large number of interesting and suggestive facts, which deserve the close attention of all students of physics; if they have not received the attention they deserve, it is largely because Prof. Righi has tended to describe his work in terms of theories which others who have pursued parallel investigations have been unable to accept.

A review is not a suitable medium for scientific discussion, and any detailed criticism of Prof. Righi's views would be out of place. But perhaps it may be useful to record some questions which inevitably occur to a reader of the chapter which deals with the effect of the magnetic field on the discharge potential, for this matter has been discussed less thoroughly than the theory of "magnetic rays" on which Prof. Righi bases his interpretation of the second group of phenomena.

Prof. Righi found that a magnetic field, whether parallel or perpendicular to the electric field, may produce either an increase or a decrease in the discharge potential. He asserts that the "accepted theory," which attributes the effect of the magnetic field to a change in the path of the ions, is inadequate to account for such a difference in the sign of the effect. As a matter of fact, there is no accepted theory which predicts satisfactorily the discharge potential in terms of the paths of the ions, even when there is no magnetic field. Changes in the discharge potential due to added electric fields (such as are produced by bringing an insulated body near to one electrode of a tube at low pressure) are at present inexplicable except in the most vague and general way; so long as such changes remain unexplained, it is quite impossible to prove that the change in the paths of the ions produced by a magnetic field must affect the discharge potential in one sense rather than the other. Prof. Righi, on the other hand, asserts that a theory which considers only the path of the ions after they are separated must predict that a transverse magnetic field will produce an increase in the discharge potential. In order to explain the occurrence of a decrease in certain conditions, an additional hypothesis is required; that which he suggests is based on the action of the field on the atom before it is ionised; he suggests that the field increases the radius of the electronic orbit in the atom, and so decreases its stability.

The first question which arises naturally is how Prof. Righi arrives at a result so directly contrary to that on which Langevin's theory of diamagnetism is based; according to the new theory, all atoms ought to be paramagnetic. The second is why he assumes, without proof, that an increase in the radius of the orbit means decreased stability. The third is whether he has attempted to calculate numerically the change predicted by his theory in the orbit; if he will do so, he will find that the change in the orbit produced by such fields as are concerned here is much too small to be likely to lead to any important change in the energy of ionisation. The fourth is why he has not attempted to apply one of the usual methods for measuring the energy required for ionisation to test his theory—and so on.

To these questions no answers are given in the volume before us. The author seems to us generally to be apt to seize with too great readiness on any explanation which will account for facts immediately under his notice, without considering with due care how it may fit in with facts less immediately obvious, and too ready to be content with qualitative explanations when quantitative explanations are required; for the same features are to be found in his treatment of the other two effects which he has studied, though they are less noticeable in his work on the "magnetic rotations" of bodies near or immersed in the discharge. They are less noticeable because the explanations which he offers are less novel. The phenomena which he describes are, as he recognises, direct consequences of the fundamental laws of electromagnetism; the criticism here would be rather that he treats individually and with unnecessary detail facts which are all illustrations of a single recognised principle. In particular, the explanation which is offered of the Hall effect, on the analogy of the "magnetic rotations," appears to differ in no essential way from that expounded in many text-books.

Perhaps a criticism of this kind is unjust, for Prof. Righi explains that he is not writing for the expert, but for the reader who wants to bring his knowledge of physics up to date. He inserts an introductory chapter for the benefit of such a

reader, giving a brief history of the whole development of electrical theory during the past century. It is always hard to lay down precisely the limits of the knowledge of the general reader; we confess that we should be surprised if anyone could be discovered who could find both something new in the first chapter and something comprehensible in the others; but on this matter the opinion of so practised a writer as Prof. Righi is not lightly to be disputed. However, we must insist that, in addressing the general reader, an author undertakes certain responsibilities. If he addresses an expert audience, he can do no harm to anyone but himself if he does not give as much weight and prominence to the views of those who differ from him as to his own; if he addresses those who are not experts, he has not the same liberty of choice in this matter. Judged on this principle, Prof. Righi's treatise will scarcely pass the test; we do not think he offers his readers a fair chance of deciding between him and his critics.

From the excellent quality of type and paper, we conclude that Italy is free from war-time restrictions, which affect our own publications so adversely. But, then, what excuse is to be offered for the absence of an index or any adequate summary of contents? N. R. C.

OUR BOOKSHELF.

Pharmacy, Theoretical and Practical, including Arithmetic of Pharmacy. By Prof. Edsel A. Ruddiman. Pp. vi+267. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 8*s*. 6*d*. net.

THE object of this little work is to present in as few words as possible essential facts which every pharmacist should know. The book is divided into three sections, viz. arithmetic of pharmacy, theoretical pharmacy, and practical pharmacy. The first treats of weights and measures, and contains a number of arithmetical calculations of a very elementary nature. Theoretical pharmacy is discussed in fifty-five pages, which, it must be admitted, would be a very meagre allowance if the subject were treated in any detail; that, however, is not the case, as it is intended that the book should be used in conjunction with the United States Pharmacopœia or the National Formulary. Practical pharmacy is dealt with in a similar manner; formulæ for the various preparations considered are not given, the author confining himself to notes on the precautions to be taken, the reactions that occur, and so on.

The work contains a good deal of information in a small compass, and it certainly comprises many essential facts that every pharmacist should know. It is not, and apparently is not intended to be, a work from which pharmacy should be studied, but is rather a summary of facts such as a student would take note of during a course of lectures and demonstrations in pharmacy. Elementary students and students revising their work before examination would undoubtedly find it useful.

Afforestation. By John Boyd. Pp. 39. (London: W. and R. Chambers, Ltd., 1918.) Price 1*s*. net.

IN this small brochure Mr. Boyd deals with the afforestation question as it now presents itself to this country. As he correctly remarks, if, after the troubles we have experienced during the past four years in providing the timber required for effectively waging the war, we have not learned our lesson we are not likely ever to do so. After briefly describing the extensive forests which existed in Scotland, now replaced by bare hill- and mountain-sides, the author points out the great dependence of the community upon the products of the forest, both in their everyday life and in industries. The great value of forestry to agriculture, and the manner in which the small holding can be placed on a sound footing by being associated with forestry, are dealt with in some detail. Mr. Boyd, with considerable practical experience of the trouble caused, speaks with authority on the game question in its application to forestry, and his remarks on rabbits, black game, red deer, and so forth are worthy of study. Some practical suggestions are made with reference to the ground to be taken up for planting, natural herbage forming a guide for the classification of areas. The author concludes with a few notes on various trees likely to be useful for afforesting waste lands.

A Manual of Elementary Zoology. By L. A. Borradaile. Second edition. Pp. xiv+616. (London: Henry Frowde, and Hodder and Stoughton, 1918.) Price 16*s*. net.

IN this new edition there are, besides smaller additions, three new chapters dealing respectively with protozoa as parasites of man, with nematodes, and with cold-blooded vertebrates. In the first of these chapters a short account is given of Entamœba, Balantidium, Trypanosoma, and Plasmodium, and of their modes of transmission. There would seem to be no sound reason for employing the name *Entamoeba dysenteriae* instead of the well-known *E. histolytica*, especially in a junior students' text-book. In the chapter on nematodes the author gives an account of Ascaris, a summary of the principal types of life-history met with in the group, and a short statement of the special characters of parasites. In the account of *Filaria bancrofti* it should have been stated that the larvæ taken up by mosquitoes finally reach the labium (proboscis), and not the salivary glands (as stated on p. 304). In the chapter on cold-blooded vertebrates the figure of the cranial nerves of the skate is not correct in certain particulars. The outer buccal nerve (part of the seventh cranial nerve) is labelled wrongly as the maxillary branch of the fifth nerve, and the real maxillary is not labelled. The direction of the internal mandibular nerve and the external mandibular are not well shown. But these are only small blemishes. The book is excellently illustrated and written with a broad outlook.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Colour of the Scales of Iridescent Insects in Transmitted Light.

CURIOUS as it may seem, the origin of the brilliant metallic and iridescent colours in birds and insects has never been satisfactorily explained, though it is generally supposed among naturalists and others that they are in some way produced by the interference of light at the surfaces of thin plates, as in the soap-bubble.

Nevertheless, various other explanations have been put forward, and Michelson, with the weight of his great authority, decides unequivocally that they are due to selective reflection at the surface of a very opaque film, as in the case of metals or dry films of aniline dyes. For this conclusion he relies upon the "rigorous optical test of the measurement of the phase-difference and amplitude ratios" when polarised light is reflected. This view has, however, by no means gone unchallenged by Lord Rayleigh, Mallock, and others.

Whatever the truth of the matter may finally prove to be, both those who uphold the theory of selective reflection, and those who uphold the theory of interference, emphasise the fact that the light transmitted through the structures must be complementary to the light which is reflected.

Thus Michelson says: "In the cases which could be investigated for this relation (unfortunately rather few) the transmitted light is complementary to that which is reflected"; and Mallock says: "In cases where the structure is transparent it transmits the complementary colour with nearly the same intensity as the colour reflected." Probably the theory of selective reflection would require the transmitted colours to be more vivid than a theory of "thin plates"; and, as Lord Rayleigh has said, the transmitted colour of the surface layer of beetles' wings (or *Emailschicht* of Biedermann, which he obtained by maceration in HNO_3, etc.) "is not nearly so full as it would be if due to anything like an aniline dye."

In spite of what is said by Michelson and Mallock, there are a number of iridescent scales in Lepidoptera, *Hypolimnas bolina*, etc., which, though perfectly transparent, are absolutely colourless. There is the still more anomalous case of the two surface layers of scales of *Morpho achilles*, and other similar species. I should be greatly interested if any of your readers could offer a probable explanation. The appearance of these scales is as follows:—They are perfectly transparent, closely striated, very thin (probably not much more than $0{\cdot}5\mu$), and by reflected light they are a bright light blue, which is practically unaltered by the angle of the incident light. *In situ* they show faint diffraction colours due to their striation. But the point to which I wish to direct attention is that, when examined by transmitted light under the microscope, they still have a *blue* colour, which is, if anything, more saturated than that shown by reflected light. This colour, though not unlike the "optical blue" of the sea and other fine suspensions, cannot be due to a similar cause, since the light transmitted is not red. It is clearly visible with a Zeiss AA objective, but practically invisible with higher powers—DD, etc. Moreover, if the scales are examined with an AA objective, and the condenser racked down, the blue colour will gradually disappear as the condenser is raised until it becomes invisible with critical illumination. These scales have, as a matter of fact, been mentioned by Biedermann, but he entirely fails to notice their significance.

H. ONSLOW.

3 Selwyn Gardens, Cambridge, March 15.

Matter and Radiation.

THE theory that matter only radiates energy to matter, as suggested by Dr. Shapley and Prof. Soddy in their interesting letters (March 13 and 20), would certainly solve the great problem of solar energy, and is in many ways attractive. But is not the evidence against it very strong? Amongst various arguments that may be advanced against it, let us consider that of the difficulty of reconciling it with the existing surface temperature of the earth.

It is evident that there is an approximate balance between the radiation received by the earth from the sun and that lost, the latter being very slightly larger owing to the heat conducted outwards from the centre. The mean temperature of the earth is about what we would expect on the assumption that it is receiving heat at a known and measured rate from the sun and radiating it uniformly in all directions in accordance with Stefan's law. The fraction of the total solid angle which is subtended by matter is apparently almost infinitesimal, yet the quantity of heat radiated agrees with that deduced from experiments in which the radiating body is entirely surrounded with matter. If we assume that surrounding matter only influences the distribution, and not the total flux of radiation, we are led into all sorts of further difficulties. For example, a large part of the radiation from the dark side of Venus would have to be directed towards the earth, so that the radiation received from Venus should be comparable with that received by Venus from the sun.

Another way of turning the same argument is to consider an isolated solar system. No heat could escape, so it would resemble a system in a perfectly reflecting envelope. Equilibrium would then only be reached when all the members had attained the same temperature. The isolation of the actual solar system in space should certainly be sufficiently close to ensure that its members would attain a temperature approximating to that of the sun.

It is possible that this argument is not new, and that there may be some way of evading it, but, as it appears to be difficult to do so, I think it is worthy of consideration.

HORACE H. POOLE.

Physical Laboratory, Trinity College, Dublin, March 26.

National Fisheries.

IN NATURE of March 13 is published a paragraph on British fisheries in which the following passage occurs:—"To the trade, fish that is scarce and dear is easier to handle than, and at least as profitable as, fish that is cheap and plentiful. From the point of view of the consumer and of the State, cheap food, a large and prosperous fishing population, and, if possible, some revenue, ought to be the objects of reconstruction of the industries concerned."

The note suggests an antithesis which has no foundation in fact. The fishing industry—producers, research workers, and the "trade"—bases the claim for reconstruction, which this association has voiced, on the fact that it desires to supply the nation with cheap fish. But cheap fish can be supplied only when plentiful catches *and regular* catches are assured, and to ensure regularity—that is the real crux—without

simplifying the existing fishery law and administration is hopeless. No one interested in the development of British fisheries believes in the economic fallacy contained in the first sentence I have quoted from your pages. To quote Mr. Secretary Cecil in 1563:—"The causes of the decay of fishing must be the lack of the use of fishing, which must be divided into ij partes, small eating of fisshe in ye Realme, and not selling of it abroad." Both these causes have operated during the war. It is our purpose to remove them both. As this is not always understood, I shall be glad if you will publish this declaration, which can be taken as "official" on behalf of every branch of the fishing marine, to which the nation owes its freedom in 1919, as it did in 1588. G. C. L. HOWELL.

National Sea Fisheries Protection Association,
Fishmongers' Hall, E.C.4, March 24.

I ENTIRELY agree with Capt. Howell, and think that the road to fishery reconstruction, in the national interest, is marked out by the lines of the propaganda of the National Sea Fisheries Protection Association. I am sorry if it should appear that anything in the views put forward in the *Times* correspondence and articles is misrepresented in the note in NATURE of March 13, but it seemed to me that Lord Dunraven's letter did suggest such an antithesis as that to which Capt. Howell refers—that fish which is scarce and dear might be more profitable and more easy to handle than fish which is cheap and abundant, and that while the former condition might possibly be preferred by the distributing trades, the latter condition is that which is favourable alike to the nation as a whole and to the consumers in particular. In order to make it impossible that the former condition might be established, Lord Dunraven seems to suggest some form of nationalisation of the fisheries; this would also, he hopes, create revenue. The National Sea Fisheries Protection Association, on the other hand, seeks to secure the same object by its advocacy of a strong Imperial administration—a sounder method, it seems to me, for better than State revenue would be a prolific fishery population retaining its individuality; and largely increased British exports would be preferable to Lord Dunraven's Colonial imports. The note was intended to be purely descriptive, and so my personal opinions were not expressed.

THE WRITER OF THE NOTE.

Coal in Thrace.

I AM much obliged to Prof. Louis for his interesting information (NATURE, March 20, p. 45).

I assumed the coal to be anthracite on account of the assertion that the use of the bellows extinguished it, while it encourages the combustion of bituminous coal by a fuller supply of oxygen. The high temperature needed for the burning of anthracite would not be attained, I fancied, owing to the cold blast.

The geographical description does not apply to Pontos.

There is another "wonder" cited by Antigonos that has a possible bearing on the coal district of Thrace. He quotes Eudoxos as saying: "It is related that in the Thracian Sea, at the mountain which is called Sacred, during certain times bitumen (*asphaltos* in the Greek) is borne on the surface."

The *Mare Thracicum* in Kiepert's atlas extends from Thrace north of the Hellespont to the coast of Thessaly. The "Sacred Mountain" is probably Mount Athos, which in vulgar speech is still called "Hagion Oros." EDMUND M'CLURE.

80 Eccleston Square, March 24.

THE MACHINERY OF GOVERNMENT.[1]

"A MAN without a purpose," said Carlyle, "is like a ship without a rudder." What is true of an individual is in this case true of a community: a people without a common purpose can make no permanent progress. It must stagnate and ultimately disintegrate. In the last resort a free people can only be held together by either of two means: custom or community of purpose. It is not difficult to see that anything—and not least the machinery of Government—which facilitates the coherence of free people, whether in a single State or in a world commonwealth, and their co-operation towards the fulfilment of a common purpose, makes for the welfare and advancement of mankind.

During the war many English customs have been broken down, but the consequent tendency towards disintegration has been more than counterbalanced by the increased sway of a common purpose. Higher efficiency and more rapid progress have consequently become apparent in multifarious departments of the national life, as, for example, the exhibition of British scientific products held in London last summer, and repeated this winter in Manchester, has shown in the case of scientific industry. But with the signing of the armistice community of purpose began to lose its hold, and disintegration threatens to set in. Labour leaders are warning the nation against it, and leading articles in the *Times* are echoing and emphasising their warnings.

How is this danger to be avoided? New habits and customs take time to form. Moreover, as we may perhaps learn from the Americans, bondage to custom causes many of the evils that result from other kinds of fetters. So the prosperity, progress, and even preservation of the State demand, above all, community of purpose. Perhaps spiritual ideals alone can supply it, and the essential emotional drive towards its realisation. But, whatever the purpose be, some central Government is needed to plan and to direct the advance towards it. This—and not merely to police the route—is the function of the Government of a State.

In the past, of course, this function is very far from having been fulfilled, whether by Ministers of the Crown, who determine policy, or by the permanent Civil Service Departments, which pursue it. When Mr. Gladstone entered Parliament in 1832 he thought his first concern would be with questions of the succession to certain unstable European thrones. A dozen years later, after a close connection at the Board of Trade with the leaders of British industry and commerce, he held a very different view. But it has taken a long time for these industrial statesmen, these leaders of British activity outside the House of Commons, to see in the Government and its principal Departments the natural centre and focus of their activities in the service of the State. The process is not yet complete; nor have some captains of

[1] Report of the Machinery of Government Committee. Ministry of Reconstruction. (Cd. 9230.) (H.M. Stationery Office.) Price 6*d*. net.

industry yet recognised that they are in business primarily to serve their fellow-men, and not for private profit. They have looked upon the Government Departments with distrust, avoided their co-operation for fear of their control, and thought of them as circumlocution offices bound, and anxious to bind, by red tape.

It can scarcely be denied that hitherto many Government Departments have not been so much concerned with pointing out the line of progress and making it the line of least resistance as with hedging it about with restrictions. The functions assigned to the different Departments of State have, in many cases, been so multifarious that it has been impossible for the permanent heads of these offices to know their job, or explain it to the Minister who is responsible for it to Parliament. So it happens from time to time that Ministers are made to display, across the floor of the House of Commons, an abyss of ignorance that would be comic were it not so fraught with dire consequences. Departments, being aware of this risk, have been afraid of exposing their ignorance. Deficient in knowledge, they have sought to evade rather than to remove difficulties. Thus has come to pass the hand-to-mouth existence of some Government Departments. They have aimed at sending a deputation away smiling, or at avoiding a question in the House, rather than at mastering their business and convincing the public of the wisdom of their policy. Moreover, their duties being too big, they have often simplified their problems by reducing them to writing, and have afterwards ignored the more complicated reality. They have been content to administer printed regulations, and almost to forget the thing itself. So it has even happened that a permanent Civil Servant, desirous of spending a few weeks away from Whitehall in intimate personal contact with the real thing, has been told by a superior officer that he was not concerned with the thing itself, but with the papers about the thing!

The impossibility of expert knowledge of so many different matters as some Departments have had to administer has tended to put expert scientific knowledge—and not of physical science alone—at a discount throughout the Civil Service. Not wanting knowledge, they have sought for ability, and have attracted many of the ablest students of Oxford and Cambridge into their service. Since the nature of the case has prevented these able young men from becoming expert, and so has, in a large measure, wasted their abilities, the increasing drain upon the universities' output of first-rate men was, just before the war, becoming a menace to the country. On the other hand, the very able men who formed the highest ranks of the Civil Service were ready to administer anything, ready to move (like Cabinet Ministers) from education to Admiralty, or from the Board of Trade to the India Office. Men of like ability have achieved magnificent success in India and the Colonies. But in Whitehall it would be possible to combine expert knowledge with ability, and so vastly to increase the efficiency of the machinery of Government.

To effect the necessary change, Lord Haldane's Committee proposes that the business of the various Departments of Government shall be distributed so far as possible according to the class of service with which they are concerned.

In accordance with this principle, the Government is to guide, and not merely to regulate, the progress of the community. To this end it is to have more, instead of very much less, relevant knowledge available than any individual or group of individuals. This knowledge is to be provided by a Department of (1) *Research and Information*, which will continuously acquire knowledge and prosecute research in order to furnish a proper basis for authority. The information required by the Royal Commissions of the future will be ready to their hand, instead of, as at present, having to be reassembled by each new Commission that may be appointed. Moreover, each other Department of State is, the Committee recommends, to have its own special department of inquiries to keep in touch with the central Research Department, and to supply to the heads of its own office and to the public the kind of information which Joan and Peter's guardian, in Mr. Wells's recent volume, sought in vain at Whitehall. Again, the heads of each Department are advised to set aside certain regular times for looking ahead and framing a policy of progress that might well be recommended to many heads of extra-Government concerns.

In order that citizens may be efficient workers for the common purpose (and that means, for the most part, efficient ministers to the needs of their fellows), they need education; healthy conditions of life (which mean adequate town planning, housing, medical service, health insurance, and the like); food, clothing, and other consumable goods (which mean adequate production, distribution, and transport); suitable regulation of conditions under which they work in the service of their fellows; and protection from the interference of hostile persons at home and abroad. With the provision of these further services the Committee proposes that the following Departments shall be respectively concerned:—(2) *Education*; (3) *Health*; (4) *Production*; (5) *Employment*; (6) *Justice*; (7) *National Defence*; (8) *Foreign and External Affairs*.

Since the Minister of Production cannot supervise privately controlled industry and commerce, and also direct competing services which the Government is providing on its own account, there must also be a Department of (9) *Supplies* to fulfil this latter function. And, finally, since the State must cut its coat according to its cloth, there must be a Department of (10) *Finance*.

The reorganisation of the Civil Service so as to form the ten Departments named in the Committee's report would bring the leaders of national life outside Government circles—the statesmen of industry and commerce—into closer touch with the Government to the advantage of both; just

as educators throughout the country already co-operate with their friends at the Board of Education, whom, more and more, they look upon as colleagues who share their interests and spend themselves in the same service. Thus will every walk in life come to be regarded as a branch of public service. Just as the Board of Education is aided by the Teachers' Registration Council as an advisory body, so the joint standing industrial councils that are being established according to the Whitley Committee's report may, before long, become advisory bodies to the new Ministries of Employment, Production, and Supplies.

The reform of the machinery of Government proposed by the Committee would, moreover, render it possible for all the higher officers of the ten Departments to be experts in their respective professions. They would then be better able to work intelligently for a definite purpose than is possible for mere administrators of miscellaneous regulations. We have advisedly stated that *all* the higher staff of each of the new offices should be expert; for the Committee, taking the Board of Education as a model, in many respects, of what the new Departments should be, would apparently be content with expertness on the part of the inspectorate alone. We believe, on the contrary, that the top men inside the new Whitehall offices should be encouraged to spend part of their time outside the office, acquiring intimate personal knowledge of the activities with which their Department is concerned, and of the men who are chiefly responsible for these activities in the country. Insisting, however, as we do, that the Civil Servants of the reformed Departments shall possess expert knowledge, we are far from underestimating the extreme importance of continuing to select only the ablest men for work of the higher division. But we maintain that, unless within a few years of their appointment they show promise of becoming expert in the work of their particular Department, they should be retired from the Service. Able, detached, and serene has been the typical Civil Servant of the past. No less able must be the Civil Servant of the future. Strenuous intellectual discipline must continue to be regarded as a necessary preliminary to entering the higher division of the Civil Service. But, instead of being detached, he must make his work his hobby. He must know his job and love it. "Without passion," said Lord Haldane years ago to the students of Edinburgh University, "nothing great is, or ever has been, accomplished."

Lord Haldane's Committee recognises that a more expert Civil Service would require increased Parliamentary control if the danger of bureaucracy is to be avoided. It suggests that Parliament might retain the necessary control by appointing a series of standing committees, each concerned with the activities of one of the ten Departments. It should, however, be borne in mind that neither this nor any other means of Parliamentary control will be satisfactory unless the *personnel* of the House of Commons is equal to these new duties.[2] In this connection it is well worth considering whether at least half the members of the House of Commons, instead of only the university representatives, should not be elected on an occupational, instead of on a residential, franchise. As a rule, people engaged in the same branch of national service have in these days far more in common with one another, and would take far more interest in a member who represented them in Parliament than the miscellaneous folk whose only link is that they chance to reside in the same neighbourhood.

Lord Haldane's Committee has little to say upon the application of its principle to local government. Since the destruction of School Boards in 1902, most of the functions of local government have been performed by county, county borough, and borough councils, the concern of which is not with any particular group of services, but with particular groups of people. We are far from desiring the resuscitation of the old School Boards, or the establishment of small *ad hoc* bodies for the local control of other services. But we would point out that subdivision of local responsibility for every form of national service, according to borough boundaries, and sometimes according to narrower boundaries still, has an injurious effect upon the efficiency of some of these services quite comparable with that of the present subdivision of responsibility among the different offices in Whitehall. Particularly is this the case with education. The local organisation of education cannot be satisfactorily effected by an authority that is responsible for part only of one complete organism centred in the local university or—as in the case of Manchester and Liverpool—universities. Responsibility for the administration of education throughout such an area might well be entrusted to a department of each of some ten or twelve provincial governments that would be the supreme authorities for the manifold activities of the various minor local authorities in their respective areas. In short, it is as important to apply the principle of Lord Haldane's Committee to local government as to central government. But it will be possible to do so only by enlarging the areas for which the local governments are responsible.

It remains to add that the transition from war to peace, which renders the reorganisation of some of the machinery of Government inevitable, is the proper time for making the further changes recommended by Lord Haldane's Committee. Their need is urgent.

SIR E. C. STIRLING, C.M.G., F.R.S.

THE death on March 20, in South Australia, of Sir Edward Charles Stirling, professor of physiology at the University of Adelaide, and director of the South Australian Museum, deprives Adelaide of one of its best-known figures.

Sir Edward was the eldest son of the Hon.

[2] An article in the *Times* of January 21, corrected on January 24, has pointed out that the new House of Commons contains not one Fellow of the Royal Society who is not either a university member (Sir Joseph Larmor and Sir Watson Cheyne) or a Privy Councillor (Mr. Balfour).

Edward Stirling. He was born in 1848, and his early education was obtained at St. Peter's College, Adelaide. Later he went to Trinity College, Cambridge, where he took honours in natural science. He completed his medical education at St. George's Hospital, where he later occupied the positions of house surgeon, assistant surgeon, teacher of operative surgery, and lecturer in physiology. He became a F.R.C.S. in 1874. In 1877 he married the eldest daughter of the late Joseph Gilbert, of Pewsey Vale, and four years later returned to Australia. Sir Edward's activities in Adelaide, where he spent the remainder of his life, were manifold. For a time he practised surgery, and became a surgeon at the Adelaide Hospital and lecturer in surgery at the University. From 1883 to 1886 he was member for North Adelaide in the House of Assembly. In 1887 he presided over the Section of Surgery at the Second Intercolonial Medical Congress. In 1889 he was president of the South Australia branch of the British Medical Association, and in the following year held the presidency of the Royal Society of South Australia.

Most of Sir Edward's scientific work was published in the period 1888–1902, during which time he wrote several interesting articles for Nature. His interests were many, and he made important contributions to science in zoology, palæontology, and anthropology. His best-known work was on the marsupial mole (*Notoryctes typhlops*) (1888), on the anatomy of the female organs of generation of the kangaroo (1889), and various important observations on remains found at Lake Callabonna, which were published between 1893 and 1902, and concerned Diprotodon, *Genyornis newtoni*, and *Phascolonus gigas*. In 1894 he accompanied as ethnologist the Horn Scientific Exploration Expedition to Central Australia. He was made a fellow of the Royal Society in 1893, created C.M.G. in the same year, and for his services to science received a gold medal from the Queen of Holland. He was knighted in 1917.

Among the numerous institutions in Adelaide with which Sir Edward was associated there are two that owe much to his energy and ability—the University, where he was lecturer, and afterwards professor, of physiology, and the South Australian Museum, of which he was for many years director. His death will be deeply felt by a wide circle of people who knew him as a vigorous and kindly personality and as a staunch and loyal friend.

C. H. K.

NOTES.

The *Berliner Tageblatt* announces that Herr Hans Bredow, an engineer who was formerly a director of the Telefunken Co., has been appointed Director-General of the Imperial Postal Department, and at the same time it directs attention to the fact that this is, so far as it knows, the first occasion on which a position held in Germany, as a rule, by lawyers and bureaucrats has been filled by the appointment of an engineer. Whilst it is true that since the institution of the Reichspostamt, on January 1, 1880, as the Imperial Department responsible for posts and telegraphs no engineer has occupied the chief administrative position of Secretary of State (the former title of the permanent head of the Department), on the other hand it has to be borne in mind that technically trained men have, from the earliest days of telegraphy in Germany, held important administrative posts in the Telegraph Department. For instance, the members of the Commission for the Administration of the State Telegraphs, appointed in Prussia in March, 1849, to carry on the telegraph services, consisted of an artillery colonel as chairman, and of an engineer and a postal inspector. In later times many of the important administrative posts in the Reichspostamt have always been held by technically trained men. It can be said generally that on the continent of Europe there has at all times existed a greater appreciation of the technically trained man in the public services than is the case in this country. Many instances could be quoted of engineers holding, on the Continent, the chief administrative positions in the public Departments, such as railways, posts and telegraphs, etc., wherein the work is largely of a technical nature. The example of foreign countries could in this respect be followed with great advantage to the public services in this country.

The rumours for some time current that Sir Robert Morant was to take the chief post at the new Ministry of Health have proved to be correct. Taking advantage of the approaching retirement of Sir Horace Monro, Permanent Secretary to the Local Government Board, Dr. Addison has appointed Sir Robert Morant an additional Secretary to that Board, and has designated him First Secretary of the Ministry of Health, when formed. Secretary to the Board of Education when the changes rendered necessary by the introduction of school medical inspection were made, and first chairman of the National Health Insurance Commission, Sir Robert Morant seems fated to be called upon to play a prominent part when organisation or reorganisation is needed. That he is well fitted for the task is certain. There are, however, other advantages than those arising from his own qualifications attending the appointment of Sir Robert Morant. Associated with him in his work he is to have Sir George Newman as Chief Medical Officer and Mr. John Anderson as Second Secretary. Both these gentlemen have worked with Sir Robert Morant before, Sir George Newman at the Board of Education, where he was Medical Officer, and Mr. Anderson at the Insurance Commission, where he acted as secretary. It was inevitable, no doubt, that the chairman and secretary of the National Health Insurance Commission and the Medical Officer of the Board of Education should be accommodated at the Ministry of Health, but it is fortunate for Dr. Addison that the holders of these positions should be such men as those named.

The number of clinical themometers tested at the National Physical Laboratory since the introduction of the Clinical Thermometer Order of October last has this week reached the total of half a million. The equipment for carrying out this work at Teddington has been increased to such an extent that the number of instruments tested per week is considerably in excess of those dealt with in any year under the older conditions for the certification of clinical thermometers. At the present time it is found that the number of clinical thermometers which do not comply with the provisions of the Order amounts to about 4 per cent. of the total received. The proportion, however, varies greatly for the different makers; for one firm, the output of which is large, the average

number of rejected instruments has exceeded 25 per cent. for some time past. Further, of the numerous stocks of clinical thermometers which have been received from chemists and stores throughout the country, the number of unsatisfactory instruments falls between 9 and 10 per cent. It is of interest to note that the French Government has recently issued a decree rendering compulsory the testing of all clinical thermometers sold in France. The limits of error adopted are in agreement with those in force in this country, but the French decree very considerably restricts the types of instruments which may be offered for sale.

AT a special general meeting of the Geological Society, held on March 26, the following resolution of council was carried by 55 votes against 12:—"That it is desirable to admit women as fellows of the society." In submitting the motion, Mr. G. W. Lamplugh, president of the society, said:—"It will be within the recollection of most of the fellows that the question of the admission of women to candidature for the fellowship of the society has been raised on more than one occasion in the past. It was considered in 1889 and 1901, and, again, more systematically in 1908–9, when a poll of the fellows was taken and three special general meetings were held, with inconclusive results. It is generally recognised that the course of events since these dates has materially changed the situation. Women have been welcomed to our meetings as visitors, and we have had many examples of their qualifications for fellowship in the excellent papers which they have from time to time contributed to the society. The value of these papers has been appreciated by all geologists, and has been repeatedly acknowledged by the council in its awards. Therefore, in the opinion of the council, it is no longer reasonable to maintain a sex-bar against qualified candidates for the fellowship of the society, and I am empowered by the council to submit the above-mentioned resolution for your consideration."

AT a meeting of the Royal Microscopical Society on March 19 Lt.-Col. Clibborn made a proposition that the society should at once take measures to design and specify the British standard microscope. He suggested that (1) the stand should be designed, not as a concrete whole, but so as to admit the successive additions of other standard parts; (2) all fittings, other than optical, should be standardised; (3) each part should be made of the material best suited to the strains and wear it has to undergo; and (4) the design should aim at simplicity, a balance of the moving body in all positions, perfect rigidity, uniformity of movement round the arc traversed by the moving body, and artistic finish. It should not require clamping. Attention was directed to aluminium-bronze and rubel-bronze as materials more suitable than brass to secure rigidity for the stand; also to die-casting as a means of producing castings in unlimited number, and requiring little or no machinery. The manufacture should be carried out by precision tools and precision grinding to limit gauges, so that all the parts of all instruments would be interchangeable. It is to be noted that in 1916 a committee of the British Science Guild drafted full specifications for six types of microscopes (see Journal of the British Science Guild, January and November, 1916). This does not appear to be referred to by Col. Clibborn.

THE trustees of the British Museum have decided that henceforth for the rest of his official career Mr. C. E. Fagan's title shall be Secretary of the Natural History Departments, British Museum.

WE regret to announce the death on March 29, at eighty-six years of age, of Dr. Henry Wilde, F.R.S., distinguished by his work in applied electricity and other branches of physics.

THE annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 8 and 9. On the opening day the Bessemer medal for 1919 will be presented to Prof. Cav. Federico Giolitti, of Turin.

THE Silvanus Thompson memorial lecture of the Röntgen Society will be delivered by Prof. W. M. Bayliss on Tuesday, May 6, at the Royal Society of Medicine. The subject will be "The Electrical Changes in Active Tissues."

ACCORDING to a paragraph in the *Times* Trade Supplement for March 29, the National Council of Scientific and Industrial Research in Canada has proposed, with the approval of the Dominion Government, to establish a Scientific Research Bureau on the lines of the Bureau of Standards at Washington.

AT the annual general meeting of the Chemical Society, held on March 27, Sir James J. Dobbie was elected as president in succession to Sir William J. Pope, Dr. H. J. H. Fenton and Prof. James Walker were elected as vice-presidents, and the new ordinary members of council are Prof. F. E. Francis, Mr. J. Addyman Gardner, Dr. C. A. Keane, and Sir Robert Robertson.

APPLICATIONS are invited by the Royal Society for the two Mackinnon research studentships which are awarded annually for research in (1) astronomy, chemistry, geology, mineralogy, and physics, and (2) anatomy, botany, palæontology, pathology, physiology, and zoology. The scholarships are each of the value of 150*l*. Applications must be received not later than June 1.

SUMMER time in Great Britain came into force on Sunday, March 30, and will continue until the night of September 28–29 next. In Canada a motion to institute summer time this year was defeated in the Dominion House of Commons on March 27, while the British Columbia Legislature has passed a Daylight Saving Bill, operative from March 29. Much confusion must result from these different decisions. The railways of Canada have put summer time into operation, and so have the chief cities and towns, but in rural districts the old standard will be maintained.

WE learn from *Science* that Mr. Secretary Lane has appointed a Commission of mining and metallurgical experts to visit Europe to observe and assist reconstruction methods in the devastated regions of France and Belgium. The members of the Commission are Dr. F. G. Cottrell, chief metallurgist of the U.S. Bureau of Mines (chairman); Mr. G. S. Rice, chief mining engineer of the Bureau; Prof. F. H. Probert, consulting engineer of the Bureau and professor of mining in the University of California; Mr. R. H. Cameron, consulting chemist of the Bureau, and Mr. H. S. Gale, of the U.S. Geological Survey.

IN accordance with the express wish of the late Dr. John Foulerton, his executrix and sole legatee has transferred to the Royal Society 20,000*l*. National War Stock, the interest upon which is to be employed by the president and council in making awards to students, especially younger students, of sufficient amount to enable them to devote themselves, under the supervision and control of the president and council, to original research in medicine, to the improvement of the treatment of disease and the relief of human suffering. All awards are to be subject to the conditions that members of both sexes are to be

equally eligible, and that every candidate must show that he or she and his or her father and paternal grandfather are of British nationality; but, subject to these conditions, the awards may be made by the president and council in such manner and upon such terms and conditions as they may from time to time determine at their discretion.

By the untimely death of M. Jacques Danne, announced in last week's Nature, science loses one of its earliest workers in radio-activity. M. Danne was associated with Prof. Curie in researches upon the physical properties of radium emanation and the active deposit therefrom; they found the law of decay of the latter when a body is exposed for a long time to the emanation, and recognised that a complex series of events was here in operation. M. Danne was the director of the laboratories at Gif, which are a model of their kind. They consist of a number of small buildings designed to serve the purpose of radio-active research, and to provide the accurate measurements and chemical analyses required in the process of extraction of radium from the crude ore; this latter is carried out in a factory near by. The laboratories possess a library which contains copies of practically all the purely scientific work published upon radium and allied substances. M. Danne was the editor of *Le Radium*, the only journal of its kind dealing with all the aspects of the physical and chemical properties of the radio-active bodies. He was a man of extraordinary energy, and accomplished work of much value in radio-active fields.

A further paper on the etiology of influenza by the late Major Graeme Gibson, in association with Major Bowman and Capt. Connor (see Nature, March 13, p. 31), is published in the *British Medical Journal* for March 22, p. 331. The experiments recorded consisted of (1) the inoculation of animals with sputum from cases of influenza, (2) the inoculation of animals with blood from cases of influenza, (3) passage of the virus from animal to animal, and (4) cultural experiments and inoculation of cultures into animals. Of five monkeys inoculated with sputum collected at an early stage of the disease and filtered through a filter-candle, four gave positive results and one was negative. Positive results were also obtained with some rabbits and guinea-pigs, but not with mice. Experiments with blood were not very successful. The pathological lesions in the experimental influenza in the animals closely resembled those seen in the lungs of man. A minute coccoid micro-organism was grown by Noguchi's cultural methods from (*a*) the kidney of infected animals, (*b*) the filtrates of lung-tissue, and (*c*) the filtered sputum from cases of influenza. In view of these findings, the authors conclude that the organism isolated is capable of passing through a filter-candle, and that it is, in all probability, the cause of influenza as seen to-day.

March closed with very wintry conditions over the British Isles, frost and snow occurring generally. During the early hours of Saturday, March 29, the heaviest snowstorm of the winter was experienced. In Scotland railway traffic was delayed, and the fall of snow is said to have been the heaviest experienced for years over the Irish midlands and the west. The snowstorm was due to the passage of a subsidiary cyclonic disturbance up the English Channel. Very heavy snow fell in London from 2.30 to 7 on Saturday morning, the depth amounting to 9 in. in some of the metropolitan suburbs, and at some places in the South of England the depth exceeded a foot. Snow has often fallen later in the winter or spring, and in 1917 much snow fell both in March and April. At Greenwich the latter half of March was 7° colder than the first part of the month. The mean temperature for the whole of March was 40·9°, which is 1° below the average for seventy-five years to 1915. It is 2° colder than March, 1918, but 2·4° warmer than March, 1917. Frost was registered on the grass this year at Greenwich on twenty-four nights, and with only one exception after March 12. The total rainfall for the month measured 2·91 in. (to the evening of March 31), which is exactly double the sixty years' average. The duration of bright sunshine during the month was eighty-nine hours, and there were only six sunless days.

Some disconcerting possibilities are indicated in some notes by Mr. A. Philpott on birds introduced into Southland, New Zealand, which appear in the *New Zealand Journal of Science and Technology* (vol. i., No. 6). According to the author, in this district the introduced birds are now "much more prominent than the native birds." Some of the latter, he assures us, are still plentiful enough, and will probably continue to hold their own. It is devoutly to be hoped that this surmise will prove to be correct. But the dispossessed species can never be replaced, and they were infinitely the more valuable. Among the introduced species Mr. Philpott makes special mention of the starling, which, we are informed, is a useful bird, but not nearly so plentiful as it used to be. As it seems to be changing its nesting habits, there is a grave danger that a reversal of its rate of increase will in the near future have to be recorded. The Australians have learnt, by bitter experience, the folly of introductions of this kind. There the starling has become a pest, defying all attempts to reduce its numbers.

Anatomists and palæontologists will indeed be grateful for the studies in comparative myology and osteology which Messrs. W. K. Gregory and C. L. Camp have just published in the Bulletin of the American Museum of Natural History (vol. xxxviii., art. 15). Not only have the authors given a very exhaustive account of the muscles of the shoulder girdle and pelvis in a number of reptiles, birds, and mammals, and the homologies of these muscles; they have also essayed the difficult task of reconstructing the musculature of a number of primitive fossil reptiles. Only those who have some practical acquaintance with dissections of this kind can appreciate the immense amount of labour which they must have expended to produce results so striking. A large number of very beautiful diagrams add still further to the value of this work, of which they may be justly proud.

In the report on the Agricultural Department, Grenada, 1917–18, an account is given of further experiments with a parasitic fungus, *Sporotrichum globuliferum*, on the cacao thrips (*Heliothrips rubrocinctus*). The trees were sprayed with a powdered mixture of flour and fungus-spores suspended in water in the proportion of from 20 to 60 grams of the powder to 3½ gallons of water. The observations are not yet complete, but the experiment has demonstrated (1) that the fungus was readily distributed amongst thrips in the field, (2) that under favourable conditions of atmospheric humidity the fungus caused the death of large numbers of both young and adult thrips on the inoculated trees, and (3) that the fungus spread by natural agencies to trees outside the inoculated area. It remains to be determined whether adequate control of thrips can be secured by the use of this fungus, and how far the activity of the fungus is

limited by climatic conditions; there is also the question as to the economic production of inoculating material in quantity.

A SEVERE earthquake was felt over eastern Bengal and Assam, most of Burma, and in north-east India as far west as Lahore on July 8, 1918. Capt. Murray Stuart, who has investigated the earthquake on behalf of the Geological Survey of India, has published an interesting summary of his results (Records Geol. Surv. India, vol. xlix., 1918, pp. 173–89). Without preliminary warning, the earthquake occurred at about 3.50 p.m. (Indian standard time), at a time when most people were out of doors, so that the loss of life was exceedingly small. The epicentral area lies some hundred miles to the south-east of that of the great Assam earthquake of 1897, the centre of this area being in the Balisera Hills, about 3½ miles south of the railway at Srimangal. Nearly all brick buildings were destroyed in the area of greatest intensity, but no fault-scarps were formed, though there was much shifting and fissuring of the surface material and ejection of water and sand. Making use of Dutton's well-known method, Capt. Stuart estimates that the focus was at a depth of eight or nine miles.

IN an article on the progressive desiccation of Africa in the *South African Journal of Science* (vol. xv., No. 3) Mr. E. H. L. Schwarz discusses at length the various hydrographical systems of that continent. Certain engineering works are proposed which the author believes would have a beneficial effect on South Africa. One is a dam across the Cunene River below Kinga, in Angola, some 250 miles from the coast; the other is a dam across the Selinda River or the Chobe River a few miles above its confluence with the Zambesi. These weirs would restore to Lake Ngami its old area, fill up the Etosha pan, and inundate much of the Makarikari depression. This, Mr. Schwarz believes, would result in a greater general humidity which would have the effect of bringing rain to the Kalahari desert; otherwise he foresees desert conditions gradually spreading through South Africa. Possibly Mr. Schwarz takes an unduly pessimistic view of the future of the country, and all authorities do not agree with him in his contention that the agricultural conditions in the Karroo have changed for the worse within recent times. It is open to argument whether the creation of such an immense inland lake would have the desired effect in modifying the climate, even if the scheme were practicable, but the paper is valuable for the facts it contains and the important issues which it raises.

A QUANTITATIVE examination of the relation of rainfall to configuration in certain localities of the British Isles has been made by Mr. Carle Salter, and was the subject of a lecture to the Institution of Water Engineers. The paper is now published by the institution as a separate pamphlet. Rainfall may be classed as convectional, cyclonic, or orographical. The first two types are only slightly affected by configuration of the land, but an examination of a rainfall map of the British Isles shows that orographical rains predominate in the course of the year. In winter orographical rains are most frequent, and in summer their influence, while apparent, is not so well marked. Unfortunately, no records exist of the average amount of rain which falls annually over the sea in the neighbourhood of the British Isles. Records of this nature, if available, would give a measure of the amount of non-orographical rain which falls over the land generally. An examination of data from stations near sea-level shows that elevations of only a few feet affect the amount of rainfall. The rate of increase per 100 ft. of altitude varies within wide limits. It is lower on slopes parallel to the prevailing winds than on slopes at right angles. On fairly steep ridges close to the sea the maximum rainfall often occurs slightly on the leeward side of the crest. These and other cases Mr. Salter discusses at length with a wealth of illustration from the records of the British Rainfall Organisation. It is unnecessary to point out the great importance of researches of this nature in relation to problems of water-supply.

THE evidence of complete combustion of coal is to be sought in the flue-gases. According to the *Coal Age* for November 21 last, these gases, when the combustion of the coal is complete, consist in part of carbon dioxide, of which there should be not less than 16 per cent. When the flue-gases show by analysis less than that percentage, too much air has been allowed to pass through the furnace. Even if we admit one-third more air into the fire-box than is theoretically necessary for complete combustion, the escaping gases should contain from 20 to 22 per cent. of carbon dioxide. In practice every pound of coal burned requires for its complete combustion 200 cu. ft. of air. When burned under such conditions, a pound of coal should develop 13,000 B.Th.U.

IN a paper read to the Institution of Electrical Engineers on February 27 Drs. Barclay and Smith discussed the determination of the efficiency of the turbo-alternator. The American Institution of Electrical Engineers gives a conventional theoretical method of computing the losses, but it is known in certain cases to lead to very erroneous results. The authors have found out, by experiments carried out at Messrs. Vickers's works, that the alternator losses can be determined conveniently and accurately under actual load conditions by measuring the amount of heating undergone by the air used for ventilating the alternator to keep it cool. The method is practically the same as that described by Sir Richard Threlfall to the institution in 1903. The main improvements lie in the methods of measuring the quantity and temperature of the air. In the discussion we were surprised to hear that the "stray losses"—that is, the losses not taken into account in the usual conventional way of testing—sometimes amounted to 40 per cent. of the total losses. We should have thought that the cause of this must be fairly self-evident.

A COAL meter for boilers, made by the Lea Recorder Co., Ltd., of Manchester, is described in the *Engineer* for March 14. This meter is intended for boilers fitted with chain-grates. The amount of fuel passing under the fire-door depends upon the depth, *i.e.* the thickness of the fire, and the velocity of the fire-grate, and both these variables are taken into account by the mechanism of the meter, which somewhat resembles that of the well-known **V**-notch recorder for water measurement made by the same firm. Tests have been made at the works of Messrs. Browett and Lindley, and are said to be satisfactory. The makers give a guarantee of accuracy to within 5 per cent.

AN illustrated article in *Engineering* for February 28 gives an account of submarines built for the British Navy during the war by Messrs. Vickers. Fifty-four boats in all were built and commissioned in a period of fifty-one months; of these the details of the K type are specially interesting. These vessels have a submerged displacement of 2570 tons, and are 339 ft. long by 26 ft. 8 in. beam. The double-hull principle is embodied in a modified form. The speed is twenty-four knots on the surface, the power being obtained from twin sets of geared steam turbines, which

develop a shaft horse-power of 10,500. Steam is obtained from two boilers of the Yarrow type, working at 235 lb. per sq. in. The turbine machinery is supplemented by an 800-brake-horse-power heavy oil engine of the Vickers submarine type, which is coupled to a dynamo of the open single-armature design. The turbines are reserved for higher speeds only, whilst the dynamo, in addition to charging batteries, supplies the main motors with power for cruising at economical speeds. For submerged work the motors develop a total horse-power of 700 per shaft, and give a speed of nine knots. The motors drive the shafts through helical gearing. The storage battery for the use of the motors is divided into three groups of 112 cells per group.

THE following works are in the press for publication by the *Carnegie Institution of Washington*:—"The Cactaceæ: Descriptions and Illustrations of Plants of the Cactus Family," N. L. Britton and J. N. Rose, 4 vols., vols. i. and ii.; "A Biochemic Basis for the Study of Problems of Taxonomy, Heredity, Evolution, etc., with Especial Reference to the Starches and the Tissues of Parent and Hybrid Stocks, and to the Starches and the Hemoglobins of Varieties, Species, and Genera," E. T. Reichert; "A Biometric Study of Basal Metabolism in Man," J. A. Harris and F. G. Benedict; "Distribution of Vegetation in the United States, as Related to Climatic Conditions," B. E. Livingston and F. Shreve; "The Ecological Relations of Roots," J. E. Weaver; and "The Carbohydrate Economy of Cacti," H. A. Spoehr. *Mr. Edward Arnold's* latest announcements include the concluding volume of "Principles of Electrical Engineering and their Application," Prof. G. Kapp; "Air Navigation: Notes and Examples," Capt. S. F. Card; "Tacheometer Tables," Prof. H. Louis; and a revised and enlarged edition of the translation, by Dr. G. W. O. Howe, of Dr. A. Thomälen's "Text-book of Electrical Engineering." *Messrs. Hodder and Stoughton* are publishing "Automobile Repairing made Easy," Capt. V. W. Pagé, and a new edition of the same author's "The Modern Gasoline Automobile: Its Design, Construction, and Operation." *Messrs. Crosby Lockwood and Son* promise "Aeroplane Construction," S. Camm; "Oils, Fats, and Waxes," Dr. G. Martin; "Streamline Kite Balloons," Capt. P. H. Sumner; "The Engineer's Year-Book for 1919"; and a revision, by H. H. P. Powles, of "Clark's Mechanical Engineer's Pocket-Book." *Messrs. Gauthier-Villars et Cie* (Paris) have in preparation part iii. of Prof. E. Rothé's "Cours de Physique," dealing with "Aérodynamique"; vol. iii. of "Œuvres d'Halphen" is in the press for appearance with the same publishers, and vol. iv. is in preparation.

OUR ASTRONOMICAL COLUMN.

COMET 1914*c* (NEUJMIN).—A definitive orbit of this comet is contained in Publication of the Stockholm Observatory, vol. x., No. 6. The comet was discovered on 1914 June 24 by M. Neujmin, of the Simeis Observatory, Crimea, and fifty-one observations on thirty-six nights between that date and December 22, the majority of which were made at Mount Hamilton and Vienna, have been used to determine its orbit. The points that specially call for remark are that the orbit is hyperbolic, the eccentricity being 1·00367 ± 0·000296, and that the perihelion distance is exceptionally large—3·747. In spite of the fact that the arc of the orbit comprehended in the investigation is only 33° or 34°, the author, Mr. John Svärdson, is satisfied that the hyperbolic character of the orbit is real. The large perihelion distance is equalled only by the comet of 1729, and there are other resemblances between the orbits of the two comets—a fact which had been previously noticed. The elements found by Mr. Svärdson are given below with those of the comet of 1729 for comparison.

	1914*c*	1729
T =	1914 July 30·158 Berlin M.T.	1729 June 13 27 Paris M.T.
ω =	14° 2′ 12 5″	9° 53′ 22″
☊ =	270° 18′ 26·7″	310° 38′ 0″
i =	71° 2′ 18·4″	77° 5′ 18″
q =	3·747131	4·043496
e =	1·003672	1·0050334

COMET 1915*a* (MELLISH).—Stockholm Publication No. 5 (vol. x.) contains a definitive orbit of this comet by Mr. Rosenbaum. The orbit seems to be hyperbolic, eccentricity 1·000235, but the author is not satisfied that this is real. It may be remembered that in the middle of May the comet was observed to have two nuclei visibly separated, and Mr. Rosenbaum suggests that it is necessary to treat the observations before and after the disruption as distinct orbits.

THE CEPHEID VARIABLES.—The characteristics of the variable stars of which δ Cephei is the type furnish a problem which is occupying many minds: (1) Their variation is regular and continuous, and the rise to maximum is usually more rapid than the fall to minimum; (2) they show variation of radial velocity with the period of the light changes; (3) their spectral class varies with the period, advancing towards M as the period is longer, and also with the light variation, the stars being redder at minimum than at maximum; and (4) the period of light variation has a marked correlation with the mean absolute magnitude of any star. It is found difficult to propound a hypothesis that will account for these and other characteristics. There is good reason for thinking that the Cepheids are not binary stars. It has been suggested that they are rotating bodies hotter and brighter on one side than on the other, but this fails to fit the facts, and a third hypothesis, known as the pulsation theory, which supposes that the Cepheids are gaseous bodies alternately expanding and contracting is now under discussion. The Monthly Notices of the R.A.S. for November and January contain a thermo-dynamical investigation of this theory by Prof. Eddington, who discusses successfully the initial difficulty that the dissipation of energy would not permit the action to continue, and concludes that the hypothesis leads to results in agreement with observation in respect of (1) the absolute value of the period, which can be determined theoretically with small uncertainty; (2) the correlation of spectral type with absolute magnitude; and (3) the asymmetric form of the velocity curve.

WAR WORK OF BRITISH CHEMISTS.

THE anniversary dinner of the Chemical Society was held at the Connaught Rooms on March 27, Sir William J. Pope presiding. In proposing the toast of the Chemical Society, Lord Moulton stated that our real enemy in the war was Germany—the nation that had devoted itself *par excellence* to chemistry. Germany did not declare war until her installations for the production of ammonia and of nitrates in vast quantities were complete. Emboldened by the enormous preparation made for the supply of munitions, by the advances made in artillery, and by the decision to use poisonous gases, Germany thought she had but to strike a heavy blow and world-supremacy was hers. Lord Moulton then contrasted Germany's state of preparedness in 1914 for the production of munitions with that of England. Chemists were justified in claiming that it was they who had had to resist Ger-

many, and it was marvellous to think that, owing to their response, by the time the war was at its height England was Germany's equal, if not her superior, in chemical warfare. The nation must not again be cut off from the essential means of defence, for the possibilities of war must always be remembered. To the chemist the future prospects are limitless; the discovery of new substances, the shortening of processes, economy—all these lie in his hands. The Chemical Society is doing valuable work because it exists for the general advancement of chemical science. Lord Moulton then referred to the valuable services rendered to the country by Sir William Pope in the problems connected with explosives, in the production of poisonous gases, and in the realm of photography.

In replying, Sir William Pope stated that the society numbered some 3500 members, and though it was nearly eighty years of age, it was not the age of decrepitude. It was still prepared to produce new methods for stimulating scientific work and scientific effort. He referred to Lord Moulton as the greatest chemical manufacturer of this or any other day, and chemists feel honoured at having been made an essential part of the stupendous weapon for destruction in the forging of which Lord Moulton had played so large a part. All the resources of science had been utilised in the war without scrutiny of cost, and the result had been worth the expenditure. Unless the same resources are used in the struggle before us to develop and promote, not only applied, but pure science, then our country will fall behind. It lies with our leaders to determine to what extent science will exist in the coming great wave of intellectual and material progress throughout the world. The nation must be prepared to pour out treasure into our educational establishments for securing the potential young energy of the country and of directing it into scientific channels, and money must be poured into our universities and colleges to stimulate scientific research. Whether it be pure or applied knowledge, the dividend paid will be enormous. The great object we have in view is the increase of human knowledge, and this can be achieved only by the expenditure of large sums of money.

Prof. H. E. Armstrong, in proposing the toast of "Our French Colleagues," referred to previous exchanges of courtesies between French and English chemists, and whilst this was the first time that the French Chemical Society had been officially represented at our anniversary dinner, he hoped that it would become a regular practice in the future. In replying, Dr. C. Poulenc expressed the great pleasure felt by himself and his colleagues in being invited to take part in the first public function held by the Chemical Society since 1914, for they realised that such an invitation set yet another seal on the bond of sympathy existing between the two nations.

The president then proposed "His Majesty's Forces," to which Lt.-Gen. Sir W. T. Furse, Master of the Ordnance, made acknowledgment.

Sir James J. Dobbie, president-elect, in proposing the toast of "The Guests," referred to the pleasure the society felt in seeing such a representative gathering of guests, and though it might seem difficult to bring them all into one toast, owing to the interests they represent being so diverse, the chemist had been closely associated with them all during the period of the war. The Right Hon. Herbert A. L. Fisher, in responding for the Board of Education, referred to the place of science in national education. Though we had arrears to make up and wanted more money, more teachers, and more learners for science, in the main the battle had been won. He was of the opinion that unless the country was provided with a large and generous scheme of education, a number of talents which might be educated to a high pitch of accomplishment would be lost. Unless the community realises that science has its message, its value, that it ought to be encouraged, and that no money spent on science is wasted, science will never be in a satisfactory and wholesome condition. Sir Aston Webb replied for Art, and Sir J. J. Thomson for Science.

ENERGY TRANSMISSION.

TWO or three years ago a Rumanian engineer, Mr. Constantinesco, brought to this country a remarkable new method of transmitting energy. A pipe filled with water or a similar fluid is used. Vibrations of the nature of sound-waves are produced mechanically at one end of the pipe, and the energy of these is recovered at the other end as mechanical energy. As there is no general movement of translation of the mass of fluid, little is lost and the efficiency of transmission is high. The energy recovered can be applied to any mechanical operation. The method has been said to be an alternative to electrical transmission, and, in a sense, this is true. Certainly it will find a field in which it will compete with other modes of doing work at a distance.

Researches have been going on during the war, and many devices have been perfected. But it has been necessary to observe secrecy as to what has been done and what is contemplated. It is known that one important invention made possible by the Sonic system of transmission is the C.C. synchronising gear on aeroplanes, which arrests the action of a machine-gun while a propeller-blade is in the line of fire, so that 2000 bullets per minute can be discharged through a propeller revolving at 1000 to 2000 r.p.m.

From a statement in the *Times* of March 27 it appears that works have been established at West Drayton by the Government which will serve as a laboratory to enable Mr. Constantinesco to develop his inventions. These works were recently visited by Queen Mary, the Queen of Rumania, and a distinguished company, who followed with great attention a demonstration of the applications of the new system to various industrial purposes. Although little has so far been made public, it is known that Mr. Constantinesco has shown remarkable ingenuity and patience in devising means for applying the Sonic system to industrial operations, and he has accomplished enough to prove that his method is of the highest possible interest.

THE PROBLEM OF RADIO-ACTIVE LEAD.[1]

II.

IT appears, then, that 206, the value pertaining to uranium-lead, is a very reasonable value.

But, as has been repeatedly pointed out, ordinary lead, constituting the vast bulk of the lead in the world, has without doubt a much higher atomic weight, 207·2, not to be expected from either of the lines of reasoning just given. In order to test the uniformity of this circumstance, Baxter, with the help of one of his assistants, investigated ordinary lead from non-uraniferous ores from many parts of the world, and discovered that the constancy of its quantitative behaviour is as striking as that of copper or silver. His figures agreed very closely, within the limit of error of experimentation, with those obtained as a part of the present comparison of the two kinds

[1] Presidential Address to the American Association for the Advancement of Science, Baltimore, December, 1918, by Prof. Theodore W. Richards. Continued from p. 78.

of lead, so that there could be no question as to lack of identity of methods or precautions.

Before leaving the subject of the relative atomic weights of these two types of lead, it is not without interest to note the exact absolute weights of the atoms. If, as we have excellent reason for believing on the basis of the brilliant work of Prof. R. A. Millikan, a so-called gram-atom (the atomic weight in grams) contains 606·2 sextillion actual atoms, the weights of the atoms of the two kinds of lead must be respectively 342 and 340 septillionths of a gram. Their extreme smallness as regards bulk may perhaps best be inferred from the consideration that the smallest object visible as a point in the common microscope has a diameter probably about one thousand times as great as an atom of lead.[2]

Evidently, on the basis of the quantitative results just exhibited, we must admit that there is at least one real difference between radio-active lead and the common metal. Are there other differences?

A question as to the density of each substance, and therefore as to the bulk occupied by the respective atoms, at once arises. Since the atom of uranium-lead weighs less than the other, it must occupy less space, supposing that it has the same density; or else it must have less density, supposing that it should occupy the same space. The identity of the chemical behaviour of the two types of lead suggests the probability of the latter alternative, and this was, therefore, assumed by Soddy; but experimental proof was evidently desirable. Therefore an extended investigation of the density of the various kinds of lead was carried out likewise in the Gibbs Memorial Laboratory. As a matter of fact, the densities of the several specimens were found to be very nearly proportional to their atomic weights; that is to say, the bulk of the atom of radio-active lead is almost exactly the same as the bulk of the atom of ordinary lead, although the weights of these atoms are so markedly different.

Densities and Atomic Volumes.

	Atomic weight	Density	Atomic volume
Pure uranio-lead ...	206·08	11·273	18·281
Australian mixture ...	206·34	11·289	18·278
Pure common lead ...	207·19	11·337	18·277

A distinctive property of elementary substances, which has always been supposed to be concerned more or less definitely with the atomic weight, is the spectrum, depending upon the wave-lengths of light emitted by the vapour. But, surprisingly enough, the spectrum lines produced by these two sorts of lead, when heated to the high temperature of the electric arc, are so precisely alike, both as to their wave-lengths and their intensities, that no ordinary spectrum analysis shows any difference whatever. This has been proved by careful experiments at Harvard and elsewhere. A and B were from two different specimens of radio-active lead, C from ordinary lead, all very carefully purified. The range covered is about from 3000 to 2000 wave-length—far in the ultra-violet. Very recently Prof. W. D. Harkins, of Chicago, and two assistants have detected, with a very extended grating spectrum, an exceedingly minute shift (0·0001 per cent. of the wave-length—an amount far too small to be shown by the spectra exhibited) of one of the lines. The wonder is, not that there should be a difference, but rather that they should be so very nearly identical. Evidently the very considerable difference in the atomic weight produces only a barely perceptible effect on the wave-lengths of light emitted by the several isotopic forms of a given element, although a less difference in atomic weight between two different elements (for example, cobalt and nickel) is concomitant with utterly divergent spectra.

Another very interesting question, involving the relations of substance both to light and to weight (or rather density), is its refractive index. All the formulæ relating to molecular refraction involve the *density* of the substance concerned. In the case under consideration, do the differing weights of the atoms, and therefore the differing densities of the same compounds of the two kinds of lead, affect the refractive indices of the salts? Is the refractive index of a given salt of radio-lead identical with that of the same salt of ordinary lead? Evidence on this point would go far to decide whether density or atomic volume is the more important thing in determining refractive index. A very careful study carried out with the help of Dr. W. C. Schumb at Harvard has, within the past few months, shown that, as a matter of fact, the refractive index of ordinary lead nitrate is identical with that of the nitrate of uranium-lead within one part in nearly twenty thousand—a result which shows that density is a less important factor in determining refractive index than had been previously assumed.

Both these conclusions concerning light—that drawn from the spectra and that drawn from the refractive indices—have a yet more far-reaching interest, for they give us a further clue as regards the innermost nature of the atom. That part of the atom which determines its weight seems to have, at least in these cases, very little effect on that part of the atom which determines its behaviour towards light.

Immediately connected with the question of density of the solid salts is the question as to the densities of their saturated solutions, as well as to the extent of saturation. Fajans and Lembert had recently obtained results probably indicating that the molecular solubility of each kind of lead is the same, and that the densities of the solutions are different, the density of the radio-lead solution being less to an extent consistent with its smaller molecular weight. These results, however, left much to be desired in the way of accuracy, and needed verification. Therefore, a very careful investigation, begun at Harvard with the assistance of Schumb, before the appearance of Fajans's publication, furnished valuable knowledge on this point.

Solubility of Two Kinds of Lead Nitrate.[3]

	Common lead	Uranium-lead
Per cent. salt in saturated solution (25·00°)	37·342	37·280
Grams lead per 100 grams water	37·281	37·130
Molecular solubility per 1000 grams water	1·7993	1·7989

Here, again, differences in weight alone are manifest, and these are proportional to the differences in the atomic weights; the molecular behaviour is essentially identical in the two sorts. Hence a difference in density between the two solutions must exist, exactly consistent with the difference in the atomic weights.

The identity in solubility might also be inferred from the impossibility of separating the two kinds of lead from each other by fractional crystallisation. This was predicted by Soddy, and tested by him and by others. Various vain attempts have been made to separate the different kinds of lead from one another,

[2] If the smallest object visible in a microscope could be enlarged to the width of this printed page, the atoms in it would appear about the size of the dots on the letters *i*, or the periods, in the type above.

[3] The uranium-lead used in these determinations was a specimen from Australia having the atomic weight 206·41, not quite like the earlier sample, but not different in important degree.

but apparently when once they are mixed no chemical method can separate them, since the properties of the different kinds are so nearly alike. The latest attempt at the Gibbs Memorial Laboratory involved one thousand fractional crystallisations of the Australian lead nitrate, which is believed to contain both ordinary and uranium-radium lead. The extreme fraction of the crystals (representing the least soluble portion, if any difference in solubility might exist) gave within the limit of error the same atomic weight as the extreme fraction of the mother liquor (representing the most soluble portion), thus confirming the work of others in this direction.

When wires constructed of two different metals are joined, and the junction is heated, an electrical potential or electromotive force is produced at the junction. This property seemed, then, to be a highly interesting one to test in order to find out how great may be the similarity of the two kinds of lead. In fact, wires made of radio-active lead and ordinary lead tested in the Gibbs laboratory gave no measurable thermo-electric effect, the wires acting as if they were made of the same identical substance, although the atomic weights and densities were different. No other known case of this sort is known, so far as I am aware. The melting points of the two kinds of lead were likewise found, with the assistance of N. F. Hall, to be identical within the probable accuracy of the experiment.

Let us bring all these results together into one table, so that we may better grasp their combined significance.

Summed up in a few words, the situation appears to be this: At least two kinds of lead exist—one, the ordinary metal disseminated throughout the world, in non-uraniferous ores; another, a form of lead apparently produced by the decomposition of uranium, radium being one of the intermediate products. If we leave out of consideration the probably inessential difference in radio-activity, the two kinds are very closely, if not exactly, alike in every respect excepting atomic weight, density, and immediately related properties involving weight, such as solubility. Thorium-lead appears to be a third variety, with similar relations. Shall we call these substances different elements, or the same? The best answer is that proposed by Soddy, who invented a new name and called them "isotopes" of the same element.

Comparison of Properties of Different Kinds of Lead.[4]

	Common lead A	Mixture (Australian) B	Uranio-lead C	Percentage difference A–B	Percentage difference A–C
Atomic weight	207·19	206·34	206·08	0·42	0·54
Density	11·337	11·280	11·273	0·42	0·56
Atomic volume ...	18·277	18·278	18·281	0·01	0·02
Melting point (absolute)	600·53	600·59	—	0·01	—
Solubility (metal as nitrate)	37·281	37·130	—	0·41	—
Refractive index of nitrate	1·7815	1·7814	—	0·01	—
Thermo-electric effect	—	—	—	0·00	—
Spectrum wave-length	—	—	—	0·00	0·00

Since every new fact concerning the behaviour of the elements gives a new possible means of discovering something about their nature, and since these facts are of an especially significant kind, the anomaly is of more than passing interest, and may be said to constitute one of the most interesting and puzzling situations now presented to the chemist who looks for the deeper meanings of things.

[4] For the sake of better comparison, the values given are all those found at Harvard, since they all involved nearly the same material. The results of experiments elsewhere, so far as they cover the same ground, are essentially identical.

Many new queries arise in one's mind from a study of the data. Among them is a question as to the nature of ordinary lead, which possesses a less reasonable atomic weight than the radio-active variety. Why should this state of things exist?

Ordinary lead may be either a pure substance or else a mixture of uranium-lead with lead of yet higher atomic weight, perhaps 208. The latter substance might be formed, as Soddy points out, if thorium (over 232) lost six atoms of helium, and he and Hönigschmid have found quantitative evidence of its existence in thorium minerals.

After reviewing all the data, Prof. F. W. Clarke has brought forward an interesting and reasonable hypothesis explaining the difference between the several kinds of lead. He points out that, whereas we have every reason to believe that uranium- and thorium-lead are the results of disintegration of heavier atoms, ordinary lead may be imagined to be the product of a far earlier synthesis or evolution from smaller atoms. The hypothesis might be supported by the analogy of the synthesis and decomposition of organic substances, which by no means always follow similar paths; it seems to be consistent with most, if not all, of the facts now known.

On the other hand, may not the uniformity of ordinary lead and its difference from either of the radio-active leads be almost equally capable of interpretation in quite a different fashion? Whenever, in the inconceivably distant past, the element lead was evolved, it is scarcely to be supposed that uranium-lead and thorium-lead could have been entirely absent. The conditions must have been chaotic and favourable to mixture. When the two or more forms were mixed, none of the processes of Nature would separate them. Therefore they must appear æons afterwards in an equably mixed state on earth, constituting our ordinary lead. There may have been more than two forms of lead; but two forms, one possessing an atomic weight 206, and the other an atomic weight above 208, would account for all the facts. The identity in nature of all the common lead on earth might indicate merely that at one time all the matter now constituting the earth was liquid or gaseous in violent agitation, so that all the kinds of lead were thoroughly commingled before solidification. This explanation, if it could be confirmed, would furnish important evidence concerning the early history of planets. So far afield may a difference in weight amounting to two units in the twenty-fourth decimal place, between two kinds of atoms so small as to be far beyond the possible range of our most piercing means of actual observation, carry the inquiring investigator!

The true answers to these questions are not to be found by speculation such as that just detailed, however suggestive such speculation may be. They are to be found by careful observation. For example, the doubt as to the nature of ordinary lead can be decided only by discovering whether or not it may be separated into two constituents. Since weight (or mass) is the quality distinguishing between the several isotopes or kinds of lead, weight (or mass) must be made the basis of separation. Hence the only hope of separating isotopes of lead lies in the method of fractional diffusion, as has been already suggested by many other experimenters on this subject. Promising preliminary experiments preparatory to such an undertaking have already been begun at Harvard, and before long more light may be obtained.

The idea that other elementary substances also may be mixtures of two or more isotopes has been advanced by several chemists. Especially if ordinary lead should really be found to be thus complicated,

many, if not all, other elements should be tested in the same way. The outcome, while not in the least affecting our table of atomic weights so far as practical purposes are concerned, might lead to highly interesting theoretical conclusions.

How can such remote scientific knowledge, even if it satisfies our ever-insistent intellectual curiosity, be of any practical use? Who can tell? It must be admitted that the relationship is apparently slight as regards any immediate application, but one can never know how soon any new knowledge concerning the nature of things may bear unexpected fruit. Faraday had no conception of the electric locomotive or the power plants of Niagara when he performed those crucial experiments with magnets and wires that laid the basis for the dynamo. Nearly fifty years elapsed before his experiments on electric induction in moving wires bore fruit in a practical electric lighting system; and yet more years before the trolley-car, depending equally upon the principles discovered by Faraday, became an everyday occurrence. At the time of discovery, even if the wide bearing and extraordinary usefulness of his experiments could have been foreseen by him, they were certainly hidden from the world at large.

The laws of Nature cannot be intelligently applied until they are understood, and in order to understand them many experiments bearing upon the fundamental nature of things must be made in order that all may be combined in a far-reaching generalisation impossible without the detailed knowledge upon which it rests. When mankind discovers the fundamental laws underlying any set of phenomena, these phenomena come in much larger measure than before his control, and are applicable for his service. Until we understand the laws, all depends upon chance. Hence, merely from the practical point of view, concerning the material progress of humanity, the exact understanding of the laws of Nature is one of the most important of all the problems presented to man; and the unknown laws underlying the nature of the elements are obviously among the most fundamental of these laws of Nature.

Such gain in knowledge brings with it augmented responsibilities. Science gives human beings vastly increased power. This power has immeasurably beneficent possibilities, but it may be used for ill as well as for good. Science has recently been blamed by superficial critics, but she is not at fault if her great potentialities are sometimes perverted to serve malignant ends. Is not such atrocious perversion due rather to the fact that the ethical enlightenment of a part of the human race has not kept pace with the progress of science? May mankind be generous and high-minded enough to use the bountiful resources of Nature, not for evil, but for good, in the days to come!

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BRISTOL.—In the university courses for training engineers in the United States and Germany a certain amount of business training is given, with the result that in these countries there are many more engineers directing and administering engineering concerns than is the case in Great Britain. At the suggestion of the Dean of the faculty of engineering of the University, Dr. Wertheimer, the Senate has now decided that in future the curriculum for the B.Sc. degree shall include attendance at a course dealing with book-keeping, methods of administering and organising works, elements of commercial law, depreciation, estimating, costing, and the writing of specifications.

CAMBRIDGE.—Major H. McCombie, lecturer in chemistry in Birmingham University, has been elected to a fellowship at King's College.

LEEDS.—The council of the University has accepted with regret the resignation of Dr. C. Lovatt Evans, professor of experimental physiology and experimental pharmacology, who is leaving the Leeds Medical School at the end of June next in order to undertake research work in the Department of Pharmacology and Biochemistry of the Medical Research Committee.

LONDON.—Capt. J. R. Partington has been appointed as from April 1, 1919, to the newly established University chair of chemistry tenable at East London College. In 1910 Capt. Partington was elected Beyer research fellow of the University of Manchester, and in 1911 he was awarded an 1851 Exhibition scholarship. From 1911 to 1913 he studied under Profs. Nernst and Planck at Berlin. In 1913 he was appointed assistant lecturer and demonstrator in chemistry at Manchester, and, having served in the Army from 1914–16, he was recalled to take charge of research in the Ministry of Munitions Inventions Department. His principal publications are "Higher Mathematics for Chemical Students" and "A Text-book of Thermodynamics."

It can now be announced that the anonymous donor who in 1911 presented to the University the sum of 30,000*l.* for the erection of a school of architecture, a department of eugenics, and sculpture studios at the college is Sir Herbert H. Bartlett, Bart. The School of Architecture and the Department of Eugenics have been already completed, and the Sculpture Studios, towards the cost of which Sir Herbert Bartlett has presented an additional sum of 1000*l.*, will be put in hand immediately.

An offer by Mr. G. S. Baker of 500*l.* for the foundation at University College of a prize for the encouragement of botanical research to be named after his daughter, the late Dr. Sarah M. Baker, an old student and member of the staff of the college, has been accepted by the Senate with thanks.

Owing to ill-health, Prof. Vaughan Harley has resigned the chair of pathological chemistry, which he has held for twenty-three years.

The degree of D.Sc. in biochemistry has been conferred on Mr. E. C. Grey, an internal student, of the Lister Institute of Preventive Medicine, for a thesis entitled "The Enzymes of *B. coli communis*."

MR. A. P. MCMULLEN, senior science master, Royal Naval College, Dartmouth, has been appointed Adviser on Education, Admiralty.

THE *Pharmazeutische Zeitung* reports the following changes in German botanical chairs:—Prof. Ludwig Jost, of Strasburg, succeeds at Heidelberg Prof. G. Klebs, who died last October in his sixty-first year, and Dr. W. Ruhland, of Halle, succeeds Prof. von Vöchting at Tübingen.

IT is announced in *Science* that the Carnegie Corporation of New York has voted a grant of 100,000*l.* to the Medical Department of Queen's University, Kingston, Ont. This grant is related to that in the will of Dr. James Douglas, New York, and is conditional on an additional 100,000*l.* being raised.

THE committee of the Summer School of Civics and Eugenics has arranged to hold its second school in August next, during the first two weeks. The centre selected for the meeting this year is Cambridge. The programme will fall into two portions, the first week being devoted to a preparatory course dealing with the scientific bases of educational and social work, and the lectures of the second week with special applications of civics and eugenics

to the work of the teacher and social worker respectively. All communications should be addressed to the Secretary, Summer School of Civics and Eugenics, 11 Lincoln's Inn Fields, London, W.C.2.

THERE are about to be submitted to the Senate of the University of London, in the interests of demobilised officers and men, of released war-workers and other persons, proposals for starting next session within the University a special two years' course of comprehensive study for intending journalists, and for instituting a University diploma in journalism to be awarded after examination to students taking the special course. The proposals have been drafted by a committee formed of leading members of the University of London under the chairmanship of Sir Sidney Lee, Dean of the faculty of arts, in conference with the chief officers of the Institute of Journalists and representatives of the Appointments Department of the Ministry of Labour and of the Board of Education. Persons interested in the matter are invited to communicate, by letter only, with Sir Sidney Lee at the University of London, South Kensington, S.W.7, and to place the words "Courses for Journalists" on the outside of the envelope.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 20.—Sir J. J. Thomson, president, in the chair.—Dr. C. **Chree**: Magnetic storms of March 7–8 and August 15–16, 1918, and their discussion. The storms were of the same general type as one which occurred on December 16–17, 1917, and was discussed in a previous paper; but, unlike the previous storm, they both had conspicuous S.C.'s ("sudden commencements"). The movements constituting the S.C. on August 15–16 were unusually large, and their oscillatory character was very prominent at Agincourt and Eskdalemuir. In both cases, as in the storm of December, 1917, disturbance was much larger at Eskdalemuir than at Kew, especially in the vertical force. The declination changes at the two places showed rather a close resemblance, but the variations in the other elements differed at times not merely in amplitude, but also in general character. The disturbance at Agincourt on March 7–8 was similar in intensity to that at Eskdalemuir, but conspicuously different in many details. There were some exceedingly large and rapid changes, especially of declination and horizontal force, at Agincourt, the range of the former element being about 2° 5′, as compared with 51′ at Kew.—L. C. **Martin**: The transparency of biotite to infra-red radiations. The paper describes a curious reversible variation with temperature in the infra-red transmission of biotite. Tables and curves showing the variation in transmission of biotite with wave-length at various temperatures are given, and certain possible explanations are examined. The general nature of the effect is a halving of the transmission for a rise in temperature of about 200° C.

March 27.—Sir J. J. Thomson, president, in the chair.—H. L. **Hawkins**: The morphology and evolution of the ambulacrum in the Echinoidea.—Dr. R. **McCarrison**: The genesis of œdema in beri-beri.

Physical Society, February 28.—Prof. C. H. Lees, president, in the chair.—P. R. **Coursey**: Simplified inductance calculations, with special reference to thick coils. The method of calculation advocated in the paper is based on an extension of Nagaoka's formula for single-layer coils, to include as well all ordinary forms of thick coils. Rosa's formula for thick coils is put into the same form as Nagaoka's, and its use enables a series of correction factors to be calculated for various coil thicknesses. By the aid of a single sheet of curves giving values of these correction factors the inductance of any form of coil likely to be met with in practice may be readily calculated, using only one simple standard formula for all cases.—Dr. R. **Dunstan**: Acoustic experiments in connection with whistles and flutes. Experiments were made with hollow spheres, cylinders, and cones with holes of various sizes and in various positions. Bernoulli's theorem, which gives the wave-length of the sound produced by a cylindrical pipe in terms of the length of the pipe and an end-correction depending on the diameter only, was shown to be inadequate for practical purposes, the pitch depending on many other factors, such as the wind-pressure, the size and shape of the blow-hole, etc. Cylindrical flutes appear to require an end-correction which—within certain limits—is equal to D^2/d, where D is the diameter of the pipe and d the mean diameter of the mouth-hole (which is often oval in shape). In the shortest flute experimented with, which was only ½ in. long, Bernoulli's theorem would give the wave-length as 2 in., whereas it was actually 14 in. The conclusions drawn from the experiments are that in blowing across a hole in a hollow body a force existed on an elastic substance. The result is a "*spring back*," which produces an aerial throb, puff, or pulsation. The frequency of the pulsation is determined by relations between the dimensions of the instrument, the size of the hole, the wind-pressure, etc. Any resulting sound has its wave-length determined by the frequency, and not *primarily* by the dimensions of the instrument, as in the usual text-book treatment.—G. **Brodsky**: A new polariser. In the course of experiments with polarisers built of piles of glass plates disadvantages due to bulkiness of the apparatus and loss of light had to be overcome. The idea occurred to the author to place the pile of plates between two prisms of the same glass in such a manner as to (*a*) reduce the length of the polariser by one-half; (*b*) utilise the full aperture of the pile; and (*c*) get rid of *all* reflected light. Results obtained with experimental prisms were so good that they could be considered a very fair substitute for Nicol prisms of corresponding size, and the very small amount of light escaping through crossed prisms (which could be reduced further by additional plates) is for most purposes negligible. There would be no difficulty in building such polarisers to any required size, as all the material consisted entirely of glass in unlimited quantities and at a reasonable price, and it was hoped that this invention (British patent No. 121,906) would be used for many purposes. Experiments with piles of glass plates showed a very large discrepancy between the calculated and observed angle for best extinction. Whatever the glass used, and whatever the quality of the surface, this discrepancy came consistently to some 10°, whereas thin microscope-cover plates were found to be useless. There seemed to be still an interesting field for investigation as to the conditions affecting the surface of glass plates used in polarisers.

Aristotelian Society, March 17.—Dr. G. E. Moore, president, in the chair.—A. E. **Heath**: The scope of the scientific method. Though the man of science makes a conscious effort to avoid anthropocentric bias in his treatment of any field, this does not mean that he is confined to non-human fields. Ethical neutrality of method does not imply limitation to an ethically neutral subject-matter. Consequently it is held that the scientific method can be applied to any domain of experience. This thesis is supported by:—(1) The claim that what is attempted is always the complete description, by both qualitative and quantitative for-

mulæ, of an unanalysed field of "primary fact." This is accomplished by the setting up of appropriate conceptual constructions by the two processes of abstraction and of generalisation by analogy, the method being sterilised by constant reference back to primary fact. (2) It is then shown in detail that such synthetic ordering of a primary field is both possible and helpful in biology, political theory, history, and æsthetics, though in the more concrete fields only qualitative treatment is as yet possible. (3) Finally, it is contended that the business of philosophy is the analysis of the primary data accepted uncritically in each field. Its method is thus a "reverse scientific method." One is ready to increase hypothetical entities for the purposes of economical description, according to Mach's principle; the other limits entities to those left after radical analysis, according to Ockham's principle of parsimony. The two principles are not contradictory, but complementary.

Linnean Society, March 20.—Sir David Prain, president, in the chair.—F. **Lewis**: Notes on a visit to Kunadiyaparawitta Mountain, with a list of the plants obtained and their altitudinal distribution. This curious mountain is nearly due west of the sacred "Adam's Peak," and rises abruptly to an altitude of 5186 ft. above the sea, and is surrounded by forest. The summit is small in extent, surrounded by precipices, in the path of the south-west monsoon, which strikes on this isolated peak and by its force dwarfs the vegetation on it. The rainfall on the eastern base is about 230 in. per annum, and on the western side about 330 in. yearly. The flora appears to be largely endemic, animal life is practically absent, and wind transport of seeds of those plants which are on the summit seems unlikely. Forty-nine plants were collected on the mountain-top in one day's visit, and were determined at Peradeniya, and the names are appended to the paper; of the forty-nine, ten only are found outside Ceylon, the remainder being endemic.—Miss M. **Rathbone**: Specimens of plants preserved by submitting them to the action of formalin vapour. In plants preserved in this way, the microscopic characters of the tissues and the form of the flower and relationship of its parts are less altered than in dried specimens, whilst for travellers the specimens are lighter and more convenient to carry than plants preserved in spirit.—H. R. **Amos**: Wheat-breeding in Argentina. The paper deals with work done by Mr. W. O. Backhouse and the author in breeding wheats suitable for the country and its diverse climates, the northern portion being warmer than the southern, which is subject to occasional frost; consequently their requirements are not the same. Results were described of crossing "Barletta" and "Rieti," both commonly cultivated forms in the Argentine, with a Russian variety, others between a Chinese form and "Barletta," with the view of obtaining forms immune to rust and not liable to shell out the grain on harvesting.

Mineralogical Society, March 18.—Sir William P. Beale, Bt., president, in the chair.—L. J. **Spencer**: Curvature in crystals. The curvature of crystals is evidently of many different kinds, and due to as many different causes. Numerous examples, figured in the literature and illustrated by specimens in the British Museum collection of minerals, are grouped under the headings: Curved crystallites and feathery microlites, capillary habit, aggregations of crystals, interfacial oscillation, vicinal faces, bent crystals and plastic deformation, twisted crystals, and cylindrical (?) and spherical (?) crystals (a supposition leading to a *reductio ad absurdum*).—Lieut. A. B. **Edge**: Siliceous sinter from Lustleigh, Devon. The district round Lustleigh, near Bovey Tracey, is mined on a small scale for a very fine quality of micaceous hæmatite, which occurs there in well-defined lodes traversing the granite. At the Plumley Mine (now disused) on the walls of one of these lodes is found a peculiar banded material, somewhat resembling lithomarge or halloysite, which on analysis proved to be a siliceous sinter or opal, with an approximate percentage composition of silica 70, water 21, hæmatite 6, alumina, soda, and potash 3, and a low specific gravity 1·73. It is hard and compact, and shows a beautifully banded structure, the layers being tinted to varying degrees by limonite and finely divided flakes of micaceous hæmatite. The general appearance of the material and the presence of delicately overfolded ripples in the banding suggest that it was originally deposited on the walls of the lode in the form of a jelly, and solidified by loss of water. Such loss continues at a very slow rate when specimens are kept in a dry atmosphere, and after some years the surface becomes soft and powdery. The sinter is very fragile, breaking conchoidally even when most carefully handled; this may be caused by the shrinkage strains set up during solidification. The source of this hydrated silica is rather doubtful; it probably formed part of the aqueous injection which deposited the hæmatite, but may possibly have been leached from the granite during the formation of the lode.—A. F. **Hallimond**: An anorthic metasilicate from acid-steel furnace slags. A description of the slags will be communicated to the Iron and Steel Institute. The substance is a metasilicate of iron, manganese, calcium, and magnesium, and appears as flat, elongated crystals with the following characters:—Forms $b(010)$, $m(110)$, $M(1\bar{1}0)$, $p(1\bar{1}2)$, $l(10\bar{1})$, $n(3\bar{1}0)$, constants α 99° 37′, β 110° 57′, γ 82° 3′; $a:b:c=1{\cdot}156:1:0{\cdot}407$; perfect cleavages parallel to m and M, $mM=95°\ 9\frac{1}{2}'$; colour clear amber-yellow, not pleochroic; optical characters, $2V=65\frac{1}{2}°$; negative, $\beta=1{\cdot}701$; axial plane nearly normal to the cleavage zone; extinction on a, 5°; acute bisectrix nearly normal to a.—Dr. G. T. **Prior**: The meteorites Adare and Ensisheim. The percentage amount of nickeliferous iron, and the ratio of iron to nickel in it, were found to be respectively 18 and 13 in the case of Adare, and $3\frac{1}{2}$ and $3\frac{1}{2}$ in the case of Ensisheim, which results support the view that in chondritic meteorites the less the amount of nickeliferous iron, the richer it is in nickel.—Dr. G. F. Herbert **Smith**: A students' goniometer. This instrument, which was made by Messrs. J. H. Steward, Ltd., is of the type in which the direction of reference is given by the reflection of some distant object in a mirror, and in which the axis of the graduated circle is horizontal. A ball-and-socket joint provides the mirror with all the necessary adjustments in direction, and it is also movable vertically in the plane of the axis of the circle. The crystal-holder is provided with a simple and convenient form of adjustment, which enables a crystal to be measured, as regards one half, without removal from the wax. A pointer on a swinging arm facilitates the setting of the crystal in the axis of the circle.

Zoological Society, March 18.—Mr. A. Ezra in the chair.—H. R. A. **Mallock**: Some points in insect mechanics.—H. F. **Blaauw**: The breeding of *Oryx gazella* at Gooilust.

Institution of Mining and Metallurgy, March 20.—Mr. H. F. Marriott, president, in the chair.—Sir Thomas Kirke **Rose**: The volatilisation of gold. It is now well known that gold is volatile at temperatures not far above its melting point, both *in vacuo* and at atmospheric pressures, and researches have shown that the factors affecting volatilisation, apart from time, temperature, and amount of exposed surface, are (*a*) the composition of the bullion, (*b*) the composition of the gases in contact with the gold, and

(c) the movement of these gases over the surface of the metal. Nevertheless, the results of these researches do not agree, and in order to obtain further data the author instituted experiments described in this paper. He deals in detail with the apparatus employed and the methods adopted in pursuing his investigations, and gives the following conclusions as the result of his work:—(1) The true volatilisation of gold is so small as to be negligible at the temperatures of industrial melting furnaces, say 1000° to 1300° C. It is difficult to measure with accuracy the infinitesimal amounts volatilised at these temperatures. (2) It is probable that the nature of the atmosphere, provided that it is maintained unchanged, has no effect on volatilisation. Even in a strong draught the amount volatilised remains exceedingly small. (3) Certain gold alloys, when molten, take up oxygen from atmospheres containing it, and will afterwards spirt or effervesce in a reducing atmosphere until the oxygen has been removed. Similarly, hydrogen, and in a less degree carbon monoxide, are occluded by such molten alloys, and the metal then spirts in an oxidising atmosphere. In spirting, showers of globules of the alloys of all sizes are thrown up, and the smaller ones, especially those of less than 0·001 mm. in diameter, are carried away by any draught, however slight, and are difficult to recover. They can be collected by such a filter as cotton-wool. (4) The action is observable in all the alloys of gold with silver or copper. Even parted gold containing 1 part per 1000 of silver is affected, though to a far less degree than coinage alloys, gold-silver parting alloys, and similar materials. Fine silver and its alloys with copper also spirt freely. (5) It is this action which causes the unrecovered losses in melting such alloys in crucibles without a cover of slag.—W. S. **Curteis**: Cobar stope-measurement methods. This paper deals with the methods adopted in measuring the stopes of the Great Cobar Mine for the purpose of working out the pay-sheets of the miners fortnightly, in place of the former practice of paying in a final settlement when the ore was withdrawn from the stope. With this end in view two different methods were employed, according to the form and peculiarities of the stope outline, and the author sets out the two systems of calculation in great detail, accompanied by sketches in elucidation. It is found that the measurements required for this purpose are also capable of being utilised for other purposes, including the calculation of ore reserves.

PARIS.

Academy of Sciences, March 10.—M. Léon Guignard in the chair.—L. **Lecornu**: The flow of liquids. A discussion of a theorem published by Hugoniot in 1886.—M. **Hamy**: The study of the perturbations of the optical axis of a meridian telescope. An account of the method of determining the constants defined in a previous communication.—L. **Maquenne** and E. **Demoussy**: A very sensitive reaction for copper. Application to the analyses of ashes and arable earths. The reaction is based on a blue coloration developed by traces of copper salts by the action of a ferro-cyanide in presence of a trace of a zinc salt. Iron interferes, and details of its method of removal are given. The reaction can detect 1 milligram of copper in a litre of solution.—H. **Parenty**: A steam expansion controller, the reduced pressure increasing with the amount required by the main.—G. E. Hale was elected a foreign associate in succession to A. von Baeyer.—J. **Drach**: The integration, by quadratures, of the equation $d^2y/dx^2=F(x, y)$.—P. **Fatou**: Singular lines of analytical functions.—G. **Julia**: A general property of entire functions related to Picard's theorem.—A. **Buhl**: The exchange of the parameter and the argument. Analogies with the reduction of double integrals of the second species.—F. **Michaux**: Emissive theories and the Doppler-Fizeau principle. The fact that the Doppler formula is verified when the wave-length is measured by an interferometer is not in agreement with the theories of Tolman and Thomson-Stewart, but is in accord with either the theory of Ritz or that of Lorentz.—J. **Rey**: The physical properties of petrol vapour. For a petrol density of 0·8 at 0° C. the characteristic equation of the vapour is sensibly of the form $p(v+a)=RT$, where a is 0·024 and R 5·09. A formula is also deduced for the flow of superheated petrol vapour.—E. **Cornec**: The spectrographic study of the ashes of marine plants. A list is given of nineteen elements recognised by the spectroscope in the ashes of seaweed. Gold, bismuth, gallium, and germanium exist only in the state of spectroscopic trace. The elements not previously recognised in marine plants include antimony, germanium, glucinum, titanium, tungsten, and vanadium.—A. **Bigot**: The geology of the Col du Cotentin.—P. **Guérin**: *Urera humblotii* and its affinities.—H. **Coupin**: The absorbing power of the root-tip. Contrary to the view currently held, the tip of the root can absorb water in sufficient quantity to produce germination.—M. **Molliard**: Egg-albumin constitutes a complete food for *Isaria densa*.—G. **Rivière** and G. **Bailhache**: *Amygdalopersica formonti*.—J. **Chifflot**: The secretory canals of some Gesneraceæ, and in particular of those of *Monophyllaea horsfieldii*.—M. **Mirande**: The cytological formation of starch and of oil in Chara.—A. **Lécaillon**: The changes observed in the reproduction and development in Chinese polyvoltin silkworms when transported and raised in France.

BOOKS RECEIVED.

Pensions for Hospital Officers and Staffs. Report of a Sub-Committee of the Executive Committee of King Edward's Hospital Fund for London. Pp. v+273. (London: C. and E. Layton.) 7s. 6d. net.

Manual de Fabricantes de Azucar de Caña y Quimicos Azucareros. Por Dr. G. L. Spencer. Traducción autorizada de la 6ª edición Inglesa, por el Dr. G. A. Cuadrado. Pp. xvii+617. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 23s. net.

Analytic Geometry. By Prof. M. M. Roberts and Prof. J. T. Colpitts. Pp. x+245. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7s. 6d. net

Practical Pyrometry. By E. S. Ferry, G. A. Shook, and J. R. Collins. Pp. vii+147. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7s. net.

Practical Physiological Chemistry. By Prof. P. B. Hawk. Sixth edition. Pp. xiv+661+vi plates. (London: J. and A. Churchill.) 21s. net.

Food Control Mismanagement: The Tragedy of Milk Production. By Prof. R. Wallace. Pp. 40. (Edinburgh: Oliver and Boyd.) 6d.

Democratic Ideals and Reality: A Study in the Politics of Reconstruction. By H. J. Mackinder. Pp. 272. (London: Constable and Co., Ltd.) 7s. 6d. net.

National Life from the Standpoint of Science. By Prof. K. Pearson. Third issue. Pp. 106. (London: Cambridge University Press.) 1s. 6d. net.

The Function of Science in the Modern State. By Prof. K. Pearson. Second edition. Pp. vii+97. (London: Cambridge University Press.) 2s. net.

Elementary Mensuration, Constructive Plane Geometry, and Numerical Trigonometry. By P. Goyen.

Pp. viii+169. (London: Macmillan and Co., Ltd.) 3s. 6d.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, and Papers in Elementary Engineering for Naval Cadetships, July and November, 1918. Edited by R. M. Milne. Pp. 36. (London: Macmillan and Co., Ltd.) 1s. 3d.

Prothèse Fonctionnelle des Blessés de Guerre. Troubles Physiologiques et Appareillage. By Dr. Ducroquet. Pp. ii+235. (Paris: Masson et Cie.) 5 francs.

Lectures on the Philosophy of Mathematics. By J. B. Shaw. Pp. vii+206. (Chicago and London: The Open Court Publishing Co.) 6s. net.

The Human Machine and Industrial Efficiency. By Prof. F. S. Lee. Pp. vii+119. (London: Longmans and Co.) 5s. net.

Animal Parasites and Human Disease. By Dr. A. E. Chandler. Pp. xiii+570. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21s. net.

√ Notes, Problems, and Laboratory Exercises in Mechanics, Sound, Light, Thermo-Mechanics, and Hydraulics. By Prof. H. Dunwoody. Pp. v+369. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13s. 6d. net.

The Development of Forest Law in America. By J. P. Kinney. Pp. xviii+254+xxi. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11s. 6d. net.

The Essentials of American Timber Law. By J. P. Kinney. Pp. xix+279+x. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 3.

ROYAL INSTITUTION, at 3.—Prof. A. Findlay: Colloidal Matter and its Properties.

ROYAL SOCIETY, at 4.30.—Dr. T. R. Merton and Prof. J. W. Nicholson: Note on the Intensity Decrement in the Balmer Series.—Prof. E. W. Brown: The Determination of the Secular Accelerations of the Moon's Longitude from Modern Observations.—Dr. W. Rosenhain and S. L. Archbutt: The Inter-crystalline Fracture of Metals under Prolonged Application of Stress.—Dr. J. R. Airey: Zonal Harmonics of High Order in Terms of Bessel Functions.

LINNEAN SOCIETY, at 5.—W. B. Brierley: An Albino Mutant of *Botrytis cinerea*.—Dr. J. D. F. Gilchrist: The Post-Puerulus Stage of *Jasus lalandii*.—Montagu Drummond: The Ecology of a Small Area in Palestine.

CHILD-STUDY SOCIETY, at 6.—Dr. E. Pritchard: Home *v.* Institutional Training of Young Children.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Lt.-Col. A. G. T. Cusins: The Development of Army Wireless during the War.

CHEMICAL SOCIETY, at 8.

SATURDAY, APRIL 5.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, APRIL 7.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. H. E. Armstrong: Problems of Food and their Connection with our Economic Policy.

SOCIETY OF ENGINEERS, at 5.—Prof. J. Young: Modern Explosives.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Miss Czaplicka: Poland.

ARISTOTELIAN SOCIETY, at 8.—A. F. Shand: Value in Relation to Emotion.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—E. A. Alliott: Drying by Heat in Conjunction with Mechanical Agitation and Spreading.—Dr. P. E. Spielmann and F. Butler Jones: The Estimation of Carbon Disulphide. A Critical Examination of the various Methods usually Employed.—Dr. P. E. Spielmann and Dr. S. P. Schotz: The Estimation of Thiophene.—Dr. P. E. Spielmann and H. Wood: The Estimation of "Free Carbon" in Tar and Pitch.

TUESDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: British Ethnology—The People of Scotland.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Lieut. E. W. P. Chinnery: Reactions of Certain New Guinea Primitive People to Government Control.

ZOÖLOGICAL SOCIETY, at 5.30.—Dr. F. E. Beddard: Three Fœtal Sperm-Whales.—L. T. Hogben: The Progressive Reduction of the Jugal in the Mammalia.—G. A. Boulenger: Description of Two New Lizards and a New Frog from the Andes of Colombia.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—G. Hughes: The Electrical and Mechanical Equipment of the All-metal Cars of the Manchester-Bury Section, Lancashire and Yorkshire Railway.—F. E. Gobey: All-metal Passengar Cars for British Railways.

ILLUMINATING ENGINEERING SOCIETY, at 8.—J. B. Fagan: Light and Colour in Relation to Stage Production.

WEDNESDAY, APRIL 9.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—The Rt. Hon. the Earl of Durham, K.G.: Presidential Address.—Sir Philip Watts: Ships of the British Navy on August 4, 1914, and Some Matters of Interest in Connection with their Production.—Sir E. H. Tennyson d'Eyncourt: Naval Construction during the War.—S. V. Goodall: The Naval Construction Corps of the United States Navy.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. L. E. Hill: Housing and Infant Mortality.

GEOLOGICAL SOCIETY, at 5.30.—W. Whitaker: The Section at Worms Heath (Surrey), with Remarks on Tertiary Pebble-beds and on Clay-with-Flints.—G. MacDonald Davies: Petrological Examination of the Beds at Worms Heath.

ROYAL AERONAUTICAL SOCIETY, at 8.—Col. H. G. Lyons: The Supply of Meteorological Information for Aeronautical Purposes.

THURSDAY, APRIL 10.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—A. E. Seaton: The Work of the British Marine Engineering Design and Construction Committee.—Signor S. Orlando: Italian Two Floodable Compartment Cargo Steamers Built during the War.—Sir E. H. Tennyson d'Eyncourt and T. Graham: Some Recent Developments towards a Simplification of Merchant Ship Construction.—At 3.—C. I. R. Campbell: Development of Airship Construction.—W. L. Scott: Concrete Shipbuilding in the United States of America.—At 7.30.—The Hon. Sir C. A. Parsons and Stanley S. Cook: Investigation into the Causes of Corrosion and Erosion of Propellers.—J. H. Gibson: The Michell Thrust Block.

ROYAL INSTITUTION, at 3.—Prof. A. Findlay: Colloidal Matter and its Properties.

INSTITUTION OF MINING AND METALLURGY, at 5.—Major H. Standish Ball: The Work of the Miner on the Western Front.

ROYAL HISTORICAL SOCIETY, at 5.—R. A. Gregory: Science in the History of Civilisation.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—R. J. Kaula: Notes on Surface Condensing Plants, with Special Reference to the Requirements of Large Power Stations.

OPTICAL SOCIETY, at 7.30.—J. W. French: The Unaided Eye.—T. Smith: The Spacing of Glass-working Tools.

FRIDAY, APRIL 11.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—W. H. Gard: Some Experiences with Electric Welding in Warships.—Dr. J. Montgomerie: Further Experiments on the Stress Determination in Flat Steel Plates.—A. T. Wall: The Tonnage of Modern Steamships.—At 3.—J. L. Kent: Model Experiments on the Effect of Beam on the Resistance of Mercantile Ship Forms.—J. Semple: Some Experiments on Full Cargo Ship Models.

ROYAL ASTRONOMICAL SOCIETY, at 5

ROYAL INSTITUTION, at 5.30.—Sir J. J. Thomson: Piezo-Electricity and its Applications.

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ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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THURSDAY, APRIL 10, 1919.

MODERN OPTICAL INSTRUMENTS.

The Theory of Modern Optical Instruments: A Reference Book for Physicists, Manufacturers of Optical Instruments, and for Officers in the Army and Navy. By Dr. Alexander Gleichen. Translated from the German by H. H. Emsley and W. Swaine. With an appendix on "Rangefinders." Pp. xii+376. (London: His Majesty's Stationery Office, 1918.) Price 12s. 6d. net.

THE book before us is of special interest, because it is the first of several German treatises on optical subjects which were selected for translation into English by the Standing Committee on Glass and Optical Instruments, appointed in December, 1916, by the Advisory Council for Scientific and Industrial Research.

There can be but little doubt that Dr. Gleichen's book was included by the Committee primarily on account of the unusually complete descriptions and illustrations of modern optical instruments which fill the greater part of the volume. Its title is, in fact, somewhat misleading, for the theoretical part does not go beyond elementary principles, and is not by any means exhaustive even with regard to these. To be really useful, a theory of modern optical instruments must deal chiefly with the aberrations, and especially with those of higher order. For with regard to telescopes a dictum of the elder Steinheil is still true, that "all improvements of these instruments have aimed, consciously or unconsciously, at making them shorter"; with regard to microscopic lenses the chief aim is to increase the numerical aperture and to extend the useful field without loss of definition, and with photographic objectives fine definition, freedom from distortion, rapidity, and a flat field of wide angle are the principal desiderata and subjects of competition. In every case success depends almost entirely on skilful distribution of the higher aberrations and on the discovery of types in which these are of sufficiently small magnitude. On this important subject the book before us is practically dumb.

Following the eighty-four pages devoted to the elementary theory, we find chap. vi., in which the human eye is very fully and clearly dealt with. The author returns to this important subject in chap. xv., in which the more elaborate aids to defective vision are described, and ophthalmoscopes are also reviewed in a very lucid manner.

The description of telescopes is found in chap. ix. Prismatic instruments naturally receive most attention. Designers will welcome the large number of different types of erecting prisms, of which clear illustrations are given, but will look in vain for details of the essential constructional data and for a discussion of the conditions on which perfect results depend.

Rangefinders are dealt with in chap. xi. It will be taken for granted that German instruments monopolise the author's attention. This deficiency is very fully rectified by an appendix to the book, in which the translators (both of whom are members of Messrs. Barr and Stroud's staff) give a full and excellent account of British rangefinders. This appendix concludes with a description and illustrations of a captured German rangefinder made by Goerz.

Chap. xii. will be welcomed by English opticians, because it gives useful information on cystoscopes, which up to the time of the outbreak of war were practically a German monopoly.

The chapter on the microscope is too short to do justice to this instrument.

Photographic objectives are the subject of chap. xiv. This chapter contains a large amount of useful information and numerous detailed formulæ of actual lenses—mostly modern—which will provide interesting material for study by designers of such instruments.

A curious and possibly significant omission in the book is that there is no definite mention at all of submarine periscopes; there is only a vague hint on p. 160 that they "may have a length of several metres."

It will have been gathered that the work, whilst not quite answering to its principal title, contains a large amount of information not otherwise readily accessible, and that it should therefore prove of value as a reference-book. Its utility in this respect is enhanced by a bibliography and a very complete alphabetical index at the end.

The translation is very well done, and, in addition to the appendix already mentioned, the translators have inserted numerous notes at the ends of various chapters and at the foot of pages, all of which are to the point and of decided value.

A. E. C.

THE USEFULNESS OF PSYCHOLOGY.

(1) *Present-day Applications of Psychology, with Special Reference to Industry, Education, and Nervous Breakdown.* By Lt.-Col. Charles S. Myers. Pp. 47. (London: Methuen and Co., Ltd., 1918.) Price 1s. net.

(2) *War Neuroses.* By Dr. J. T. MacCurdy. With a Preface by Dr. W. H. R. Rivers. Pp. xi+132. (Cambridge: At the University Press, 1918.) Price 7s. 6d. net.

IF evidence be required as to the threadbare condition of the old gibe at psychology as a statement of obvious facts in unintelligible language, we have it in abundance in these books by Col. Myers and Dr. MacCurdy. For, while the clarity of the authors' expression is obviously the natural outcome of a firm grasp of their subjects, the facts which they present are probably far from obvious to the mind which is not conversant with the rapid progress of present-day psychology. Moreover, these unobvious facts are not mere freakish curiosities, but important strands in the material of our social life.

(1) For example, Col. Myers, in discussing the important problem of the length of the working day, does more than state the proved fact—once apparently so paradoxical, to-day merely an item in an alert mind's common sense—that diminution of hours of work may be followed by increase of output; he gives an analysis of the physiological and psychological factors affecting work, an account which explains convincingly how this may come about. We are also reminded of the necessity for helping people to realise the principles underlying efficient work, and to see the distinction between "shorthand methods of work" and "speeding-up." This education is noted as urgently desirable for both employers and employees.

In a condensed, but highly suggestive, form such problems as the investigation of individual differences, the selection of workers for special tasks, and the modern conceptions of the nature and treatment of nervous breakdown are discussed in a way which should convert many to the study of modern psychology. The success attending the early treatment of cases of mental and nervous disorder arising in our armies is graphically described, but we are reminded that "hitherto in this country, during peace-time, such neurasthenic patients have had no treatment beyond a bottle of medicine at the out-patient department of a neighbouring general hospital. They have not been admitted to a general hospital unless they have shown some functional paralysis, nor to an asylum until their condition has become one of certifiable insanity."

(2) In his treatment of the nervous breakdowns of the war, Dr. MacCurdy lays welcome stress upon a part of this subject which has tended of late to become overshadowed by others. Widespread interest has been shown in the striking "objective" disturbances of the war psychoneuroses—the blindnesses, deafnesses, mutisms, paralyses, and contractures—and by their equally dramatic cures. Dr. MacCurdy, however, does not forget that there exists another large class, the "anxiety neuroses," whose mental sufferings, although (perhaps because) they do not express themselves in obvious bodily disturbances, equally call for skilled treatment. He offers an interesting and important speculative analysis of the causes which lead to these two different groups of disability, the "conversion hysteria" and the "anxiety neurosis." The whole book is an expression of his sympathetic understanding of the mental factors which make for success or failure, not only in war, but also in peace.

The wealth of psychological material contained in these two books, and the convincing evidence of its usefulness, adequately support Col. Myers's plea for "institutes of applied psychology in each of our largest cities, which may serve as centres for attacking these practical problems with the help of experts trained both in psychology and in the particular branch in which its help is needed, and with the active, enlightened sympathy of the general public."

A MELANESIAN DICTIONARY.

Dictionary and Grammar of the Language of Sa'a and Ulawa, Solomon Islands. By Walter G. Ivens. With appendices. Pp. vii+249+11 plates. (Washington: Carnegie Institution of Washington, 1918.)

THE Solomon Islands form the racial centre of the Oceanic world. On the south are the Melanesians, on the east the Polynesians, whilst westward the Melanesians blend with the Papuans, and northward the Micronesians link both Melanesians and Polynesians to the Indonesians. In the Solomons, also, are found remnants of a more primitive people who occupied the islands before their present inhabitants came from the west. But, although thus important, the peoples of this region have received comparatively little attention from anthropologists, and there are only partial records of customs, languages, and folk-lore. In this dictionary Dr. Ivens has put together his collections of words in representative languages of one part of the Solomon group. These are the Sa'a, at the southern end of the large island of Malaita, and the Ulawa (Contrariété Island of the charts), about thirty miles to the east of Sa'a. Both languages come from a common stock, and the author has found it quite practicable to adjust grammar and dictionary to the same method of arrangement. The language fairly represents the speech of the island of Malaita, and, with the Tolo and Lau spoken to the north, forms a transition between the languages of San Cristoval and those of Guadalcanar and Florida.

The Sa'a-English part of the dictionary comprises 113 two-column pages of small but very distinctly printed type, with twenty pages of English index. Several subjects of interest are dealt with in the appendices. There is a combined grammar of the languages and an account of Melanesian linguistics, which, besides a general description, deals with such practical matters as the learning of the languages and translation work. Here the author points out the relation between Melanesian and Polynesian, and rejects the theory that Melanesians have adopted Polynesian words and forms of speech. He supports the view that the languages belong to the same family, the Melanesian being the older and less worn type. This will be evident to the student using the Sa'a dictionary. Though examples such as *maa*, eye, *i'a*, fish, might be thought loans from Polynesian, which has the words as *mata* and *ika*, other words, as, *e.g.*, *teru*, bone needle, *ute*, rain, *tala*, path, show no trace of borrowing from the Polynesian equivalents *au*, *ua*, and *ala*, because they have developed—according to fixed laws—from originals which are found even in Indonesia, as, *e.g.*, *jarum*, *ujan*, *jalan*. Sa'a turns *j* into *t*, while Polynesian loses both the *j* and the *r*.

Another linguistic problem which this dictionary may help to solve relates to the connection of the Solomon Islands with New Guinea. The Sa'a phonology is similar to that of New Guinea, espe-

cially about Hood Bay, where the names Bula'a and Hula are suggestive of Ulawa, and of Pululaha on the coast of Malaita. The New Guinea *ama*, father, *ma*, eye, *vio*, hungry, *mauu*, sleep, appear in Sa'a as *ama*, *maa*, *hi'olo*, and *ma'uru*, and there are agreements in grammar as well as in vocabulary.

These are but two of the points which may be raised by the purely linguistic portion of Dr. Ivens's book. The other appendices deal in a general way with Melanesian customs and with the romantic history of the Melanesian mission and the "yacht" cruises of its apostles Selwyn and Patteson. There is a chapter on the "blackbirds" of the labour traffic, and also an account of the Santa Cruz Islands, so tragic in geographical and missionary history.

Dr. Ivens's book will be exceedingly useful to students of Melanesian history and languages, whilst the general reader will find in his supplements a great deal of most interesting information about a region which, although so close to the great southern commonwealth, is singularly little known. SIDNEY H. RAY.

OUR BOOKSHELF.

Evolution and the Doctrine of the Trinity. By the Rev. S. A. McDowall. Pp. xxvi+258. (Cambridge: At the University Press, 1918.) Price 9s. net.

IN a previous volume, "Evolution and the Need of Atonement," Mr. Stewart McDowall sought to show the necessity for a teleological interpretation of the evolution-process. He continues his adventurous thinking, which is always welcome, and his aim is to restate the doctrine of the Trinity in terms that are consonant with modern thought, or with certain lines of modern thought. The truth of a doctrine does not stand or fall, he says, with the terminology in which it is expressed, and he considers the doctrine of the Trinity *sub specie evolutionis*, so to speak.

Starting from a theistic position, recognising the Being of God as the Ground of Reality, Mr. McDowall thinks of the material universe as the medium in which a certain definite purpose is realised—namely, the development of personality. This is a unique end which justifies the whole in a way that the Giant Reptiles, for instance, did not. According to our author, Man is in eternal life already, and his nature and experience are the same as God's, differing only in degree. The psychologist divides the mind-states into *cognition*, *affection*, and *conation*; the philosopher analyses human personality into three constituents: *will*, *intellect*, and *emotion*; the theologian conceives God as *Father*, *Son*, and *Spirit*. What is true of the developing personality of man must be *a fortiori* true of the developing personality of God. Hence the evolutionary re-formulation of the doctrine of the Trinity.

Such with all the injustice of condensation is the author's central thesis. To the conventional physiologist who sums up man as mechanism, it will doubtless appear highly metaphorical, but he might be none the worse for carefully studying, for instance, Mr. McDowall's very competent discussion of Freudian psychology. We have much doubt, however, whether the author really answers his own question in regard to the whole evolution-process: "Could the stages, even the human stage, be passing time-phases in the development of something far greater than we can even begin to understand?"

A Manual of Geometrical Crystallography. Treating solely of those Portions of the Subject useful in the Identification of Minerals. By Prof. G. Montague Butler. Pp. viii+155. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 7s. net.

IN this elementary text-book the information is given mainly in the form of a series of definitions, and is not easy to follow, even with some previous knowledge of the subject. A beginner, especially one attempting to work alone, would very likely soon become hopelessly confused. The book is, however, no doubt intended for the author's own students in the University of Arizona. The various hemihedral and tetartohedral "divisions" of each system are developed by the older method of suppression of certain faces or groups of faces of the holohedral form, and little use is made of the more important ideas of symmetry. The number of the planes of symmetry appertaining to each division is, however, clearly stated; but reference to axes of symmetry is omitted, except in the incorrect definition: "A symmetry axis is a line or direction perpendicular to a symmetry plane and passing through the centre of the object." Another definition runs: "A hemimorphic crystal is one in which the law of axes is violated"; and such crystals are disposed of in some other division. Including hemimorphic crystals, twenty-two of the thirty-two possible crystal-classes are dealt with, but, since for some of them there are no examples amongst minerals, the statement on the title-page is rather beside the point. Precise instructions for "orienting crystals" are repeated under each crystal-class, but, strange to say, few of the text-figures are set quite straight on the page. By an unfortunate error the title of the book appears on the cover as "Geometrical Chrystallography."

Highways and Byways in Northamptonshire and Rutland. By Herbert A. Evans. With illustrations by Frederick L. Griggs. Pp. xvi+367 +map. (London: Macmillan and Co., Ltd., 1918.) Price 6s. net.

PERHAPS no two counties in England have preserved their old-world charm so well as Northamptonshire and Rutland. A great deal of the daily traffic between London and the industrial North and between London and Scotland passes through them without leaving any impress upon their placid existence. Industry has not supplanted agriculture in these two counties; they still retain the characteristics of England of a century or two ago. Mr. Evans has not aimed at writing a guide-

book or a complete account of the geography and history of Northamptonshire and Rutland. He leads his readers in rambles through the countryside, dwelling principally in his descriptions on church architecture and historical anecdote. Modern developments find little place in the book, and the scenery and physical features are only lightly touched on. It is a book written by an archæologist for leisured readers of a like mind to whom Northampton and Rutland are native shires. Judged from that point of view, it is well written and full of interest. More than a hundred drawings by Mr. F. L. Griggs ably illustrate the volume, and there is a well-executed map.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Marine Research at St. Andrews.

IN his letter published in NATURE of March 27 Prof. McIntosh states that, while the country is spending large sums of money on international marine investigations, the Gatty Marine Laboratory of St. Andrews is closed for lack of funds. He also points out that the Gatty Marine Laboratory and its predecessor at St. Andrews were the institutions where many marine zoologists, now occupying important positions here and in the Colonies, received their training.

In spite, however, of the manner in which the laboratory has been ignored by the Government Departments which might have been expected to give it support, it has been the centre for important marine research, the results of which must be appealed to and recognised long after much of the undigested material accumulated under more pretentious conditions has been buried under thick layers of dust on Government shelves. It is certainly a pity that in this country the three Government Departments concerned with marine investigations work independently of one another, and that each in turn is prepared to adopt a similar policy with reference to the marine laboratories.

The marine laboratories have claims which, at the present time when schemes of reconstruction are being considered, should not be forgotten—first, as useful adjuncts of the biological teaching of our universities; secondly, as centres for training those who are to take part in marine investigations; and, thirdly, as institutions where marine investigations are carried out, often to a large extent by voluntary workers.

Surely, then, before the Government enters upon schemes of investigation, whether national or international, involving the expenditure of large sums of public money, the first endeavour should be to see that those institutions which have already proved so valuable are maintained and developed to their fullest extent.

A. MEEK.

Dove Marine Laboratory, Cullercoats,
Northumberland, March 31.

The Machinery of Government.

THE quotation from Carlyle with which the article on the above subject opens in NATURE of April 3 is singularly appropriate—"A man without a purpose is like a ship without a rudder"—and the comments of the writer are very useful. I add another quotation from a more obscure source: "A man of great knowledge and unweariable perseverance can really, by constantly pressing upon Ministers and Departments, do more than a tired and harassed official to shape public ends." There is a substratum of truth in this. The State Department lacks initiative. The Minister's time is taken up in assisting to run the political machine, in doing what is brought to him from his Department, and in seeing through such things as may arise in Parliament in connection with his Ministry. The Department itself is engaged in administrative work, and has little time, or perhaps little inclination, for devising reforms in the interests of the industry it represents. It may be argued by the Department that such is not the work of an administrative Department; and those relying on a Department for taking the initiative in any reform should consider whether they are entitled to do so.

No one should know better the wants of an industry than the more intelligent and far-seeing among the people who carry it on, and it is for them to see that some means is provided for direct access to the Department for suggestion and consultation. This can be done by the appointment of an advisory council as suggested in the Report of the Machinery of Government Committee. It is a matter of the highest importance to the industries of this country that when a Department is approached with this end in view it should receive the suggestion with sympathy.

The methods of appointing the members of an advisory council should be such as to secure, so far as possible, the appointment of men in whom those in the industry have confidence.

A. J. BRANDER.

Visualisation of Features.

MAY I direct the attention of readers of NATURE to a strange trick that I have found my memory to play me for many years? It occurs in the process of recollection of visual impressions ("visualisation") of faces.

Suppose, now, that I am attempting to visualise a face not seen for some time, and that I recollect the lower lip to be slightly pendulous, while the nose is large and rather prominent—well, I can visualise each separate feature correctly, but, so soon as I attempt to visualise the face *as a whole*, the features are grotesquely exaggerated, so that the lip (to take the above case) appears as a huge, pendulous, quite unnatural growth, and the nose as an equally absurd and grossly unreal structure.

My meaning may not be very clear to all, but if any other readers have had similar experiences, they will, no doubt, understand it. There is possibly some scientific explanation forthcoming; if so, I should be glad to hear of it.

R. F. POWELL.

Hodgsonites, Charterhouse, Godalming,
Surrey, March 19.

The "Atom."

"TO-DAY many chemists and physicists think that the chemical atoms of the last century are no longer to be considered as indivisible. In that case the old Greek name 'atom' is no longer fitting, because it denotes indivisibility." The above sentences are quoted from the presidential address of Prof. T. W. Richards, published in NATURE of March 27.

Fifty years ago Prof. Brazier taught us, his students at Aberdeen University, very emphatically that the word "atom" must be taken in its *primary* Greek meaning of *uncut, undivided*—not as indivisible, but as what had not hitherto been divided. This was long before the discovery of radio-activity.

A. A.

THE DOMINION OF CANADA'S 72-IN. TELESCOPE.

ALTHOUGH the reflecting telescope of the Dominion Astrophysical Observatory, Victoria, B.C., is exceeded in size by the 100-in. Mt. Wilson reflector, now nearly completed, it has had the distinction of being for some months the largest in operation in the world. The Government of Canada is to be congratulated on carrying through to completion during the war this great undertaking, which gives every promise, so far as quality and efficiency of the equipment are concerned, of being a very large factor in astronomical research.

A preliminary description of the mounting of this telescope was given in NATURE of February 15, 1917, but its final completion last May, and its continuous use since then in regular observational work, merit a short statement of the quality of the optical parts and of the work being done and proposed to be done with this splendid instrument.

FIG. 1.—The observatory building from the south.

The mounting was completely erected in its dome and building on Observatory Hill (Fig. 1), about eight miles north of the city of Victoria, in October, 1916, but the principal mirror and other optical parts of the telescope were not finished until April, 1918. The delay was due partly to the impossibility of obtaining a large disc of glass for an auxiliary flat to be used in testing the figure of the paraboloid, and partly to the increased difficulty in figuring caused by the presence of the central hole in the main mirror. However, the figuring was finally completed early in April, 1918, and on testing the mirror at the centre of curvature by visual measurements of the radius of curvature of several zones of the surface, and also by means of the Hartmann method of extra-focal photographic exposures, the whole surface was found to be remarkably close to the required theoretical form. The deviations of any part nowhere correspond with a greater longitudinal aberration at the principal focus than 0·25 mm. (0·01 in.), and this for a median zone. This is equivalent to a lateral aberration of less than one-tenth of this amount, or to a circle of confusion less than one-thousandth of an inch in diameter, which, bearing in mind the size of the mirror, is a remarkable perfection of figure.

The mirror with other optical parts, which arrived in Victoria on April 29, was installed and collimated and the first star spectrum obtained on May 6. Considering the size and hitherto untried features of the telescope, this speaks well for the care used in the design and construction of both optical parts and mounting. The instrument has been used continuously since, mostly in obtaining stellar spectra, and has given the utmost satisfaction.

The tests of the figure of the mirror were obtained in the optical shop under constant temperature conditions, and it was of interest to determine its behaviour under average observing conditions in its dome. Although one of the reasons for the choice of Victoria as a site for the telescope was the low diurnal range of temperature, the total range in twenty-four hours rarely exceeding 5° C., yet it was soon seen that even a smaller change than this introduced considerable aberration in the figure of the mirror. Hartmann tests made after a daytime rise of about 5° C. showed a longitudinal aberration, under correction, of nearly 3 mm., as compared with 0·25 mm.

under constant temperature. A similar test after a daytime rise of about 1·5° C. showed longitudinal aberration of only about 0·5 mm. This corresponds with a very good figure, and it was evident, if the best results were to be obtained, that some means should be adopted for reducing the change of temperature around the mirror. This was effected by permanently covering the closed section of the tube, consisting of two steel castings weighing more than 10 tons, with felted cotton about 2 in. thick. The space between the back and edges of the mirror and the bottom and sides of the cell was also packed with this felt; and a removable pad placed on thin boards laid across the top of the closed section, when the mirror is not open to the sky, completes the enclosure of the mirror.

During the daytime rise of temperature in the dome the 2 tons of glass in the mirror and the 10 tons of steel in the centre section and cell of the tube are protected by this heat-insulating material, with the result that the change of temperature around the mirror is very slow. This change amounts to only about one-third of that in the dome, and does not often exceed 1° C., with the result that the aberration is always so small as to be negligible in increasing the size of the star image in comparison with the enlargement caused by atmospheric disturbances. The quality of the optical parts and their performance since the insulating cover was applied leave nothing to be desired, and although only a few direct photographs at the principal focus have yet been made, the definition is superb, the smallest images being but slightly more than a second of arc in diameter. For use with the spectrograph a Cassegrain combination is employed: the principal mirror of 72-in. aperture and 30-ft. focus, and the convex secondary of 20-in. aperture placed about 7 ft. within the principal focus. The resulting equivalent focal length is 108 ft., and it is sufficient evidence of both the optical quality and the seeing conditions to say that frequently the greater part of the star image appears to be lost in the spectrograph slit, which is 0·3 mm. wide, and that a spectrum, of linear dispersion 35 Å. to the mm. at Hγ, of a star of 7·0 magnitude can be obtained in 20 to 25 minutes under average seeing conditions.

However good the optical parts, effective work could not be done unless the mechanical parts were so designed and constructed as rigidly and yet flexibly to carry the optical parts in their correct relative positions, and the mechanism so arranged as to enable the telescope to be pointed quickly and accurately to the desired position, and then to follow accurately the apparent motion of the star. This has been effected in the telescope in a remarkably efficient manner, and I have no hesitation in saying that this mounting sets a new standard for convenience and accuracy in operation. The telescope is set and guided by electric power having three speeds in each co-ordinate: a quick motion of 45° per minute, a fine setting motion of 10′ per minute, and a guiding speed of 0·5′ per minute, one revolution in 8 minutes, 36 hours, and 30 days respectively. The quick motion and clamps are operated from duplicate switchboards on each side of the south pier (one of these can be seen in Figs. 2 and 3), while the fine setting and guiding is done from a small, portable board carried by the observer. No fine circles are provided, but the coarse circles are graduated to minutes of time in R.A., and to 5′ in declination. In consequence, the telescope can be set easily and

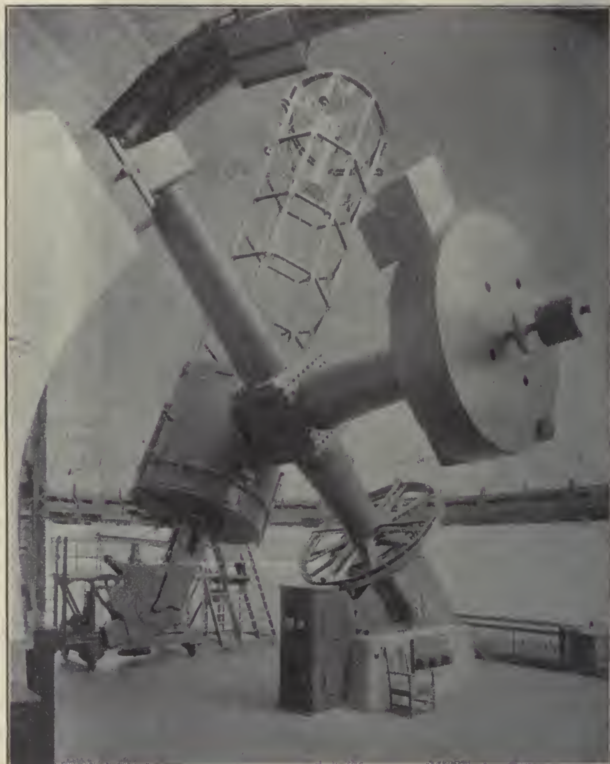

FIG. 2.—The telescope from the north-west.

quickly to within less than 2′ of the catalogue position, and identification is much simplified and charting becomes unnecessary generally for any stars brighter than, say, 7·5 magnitude. The following given by the clock is remarkably smooth and accurate, without a trace of any periodic or other drift in the image, even with the great focal length of 108 ft.; the guiding for the spectrograph is hence very easy. The slit of the spectrograph subtends angular dimensions 3″ by 0·3″, and so accurate is the driving, and so small and sharp the image in good average seeing conditions, that, unless the clock is set to drive slightly fast or slow, so that the image drifts slowly from one end to the other of the slit, the star spectrum would be too narrow or too unevenly exposed to be measurable.

Although the telescope can be easily operated by one person, ordinarily the observer is assisted by the night engineer, and it is a sufficient commentary on the perfection of the design and construction, and on the smoothness, ease, and accuracy of operation, to state that the average time required to change from star to star in making spectra, the time from the end of one exposure to the beginning of the next, is less than three minutes, and if the stars are not far separated in the sky, frequently only two minutes. When a single person is operating, these times are increased about 50 per cent., and I do not believe, notwithstanding the 45 tons weight of moving parts of this telescope, that one of one-fifth the aperture is generally handled so expeditiously.

I should not be doing what is right and just if I failed to express my appreciation of the successful efforts of the builders of this telescope to make an instrument unequalled in quality, accuracy, and convenience. The John A. Brashear Co. for the optical parts, and the Warner and Swasey Co. for the mounting, have undoubtedly added materially to their already high reputation by their marked success in this great instrument, and my gratitude and that of all interested in the progress of science is due to them for the spirit in which they attacked the problems that confronted them, and by their refusal to be satisfied, no matter what the cost, by anything but the best possible.

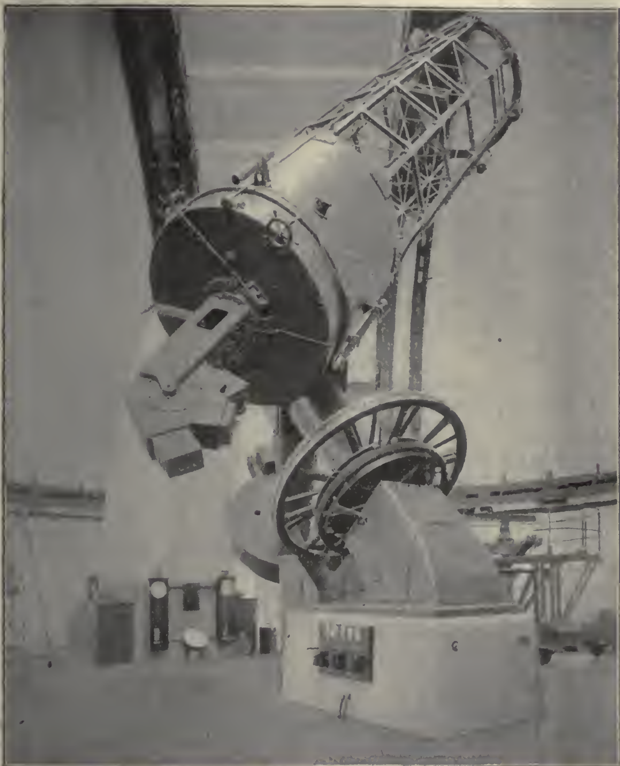

FIG. 3.—The telescope from the south-west.

As previously intimated, the greater part of the observing time of the telescope since completion has been occupied in making star spectra, 1186 spectra of stars, on the average fainter than the 6th magnitude, having been obtained by December 31, 1918. As a by-product in the measurement of some of these spectra, thirty spectroscopic binaries have been discovered. The present spectroscopic observing programme, arranged in co-operation with Mt. Wilson, consists of about 800 stars from Boss's "Preliminary General Catalogue," the purpose being to determine the radial velocity of all the stars in the catalogue not previously observed and within reach at the observatory and at Mt. Wilson in the shortest possible time. In addition, considerable time has been spent on a piece of work for the late Prof. Pickering, of Harvard, obtaining direct photographs of the Harvard regions with and without a parallel wire grating for the purpose of extending the magnitude scale in these regions to the faintest possible stars. Other work will, of course, develop as time goes on, but in the meantime, and considering the small staff—only the director and Dr. Young being at present avail-

able—it was felt that the time of the telescope would be better devoted to these two pieces of direct, useful, and much-needed work than if it were used in miscellaneous researches which, though possibly more interesting, would certainly not be so generally useful in the advancement of the science.

J. S. Plaskett.

THE USE OF ANIMALS IN MEDICAL RESEARCH.

When a Bill to prohibit experiments on dogs was before the House of Commons in 1914, a memorial signed by more than three hundred eminent physicians, surgeons, and other representatives of medical science, protesting against the measure, was addressed to the Home Secretary. The strong conviction was then expressed that the Bill would inflict very severe injury, not only on medicine and surgery, but also on the study of the diseases of animals; and the memorialists added: "We think that we have some right to ask you to oppose this attack on the advancement of medical science and practice, especially as the Final Report of the Royal Commission on Vivisection does not advise the prohibition of experiments on dogs. We are absolutely certain that such experiments are necessary for the complete study of many problems of physiology, pharmacology, and pathology."

The second reading was carried in the House of Commons before this memorial was presented to the Home Secretary, but the Bill was withdrawn in June, 1914, after a number of amendments to the principal clause had been carried in the Standing Committee appointed to consider it. The subject has, however, been raised again by the introduction of another "Dogs' Protection Bill," which received its second reading in the House of Commons on March 21, and passed through the Grand Committee stage last week. Sir Edward Sharpey Schafer, Dr. T. Lewis, Prof. E. H. Starling, and Prof. Leonard Hill have stated the case against the Bill in letters to the *Times*, and we may be permitted to recall a convincing article by the first-named in Nature of May 7, 1914, where it is shown that the prohibition of the employment of dogs for certain investigations would put a complete stop to the progress of physiology in Great Britain.

The position now is much the same as in 1914, and Sir Edward Sharpey Schafer's forcible statement in our columns of the case against the Bill is as applicable to the new measure as it was to the old. After the brilliant successes achieved during the war by physiological and scientific medicine in the preservation of life and the prevention of suffering in our armies, it might have been thought that the agitation against medical experiments on animals would have received its death-blow. But there are some people who are incapable of learning, and the passage of the Dogs' Protection Bill through the Grand Committee stage suggests that many of them are congregated in our legislature.

Do the supporters of the Bill really imagine that, since it has been proved possible to slaughter millions of human lives and to subject men and women to slow death by starvation, brutality, and disease, the value of human life has really become lower than that of a dog? For it must be remembered that the prevention and cure of disease are possible only by means of an accurate knowledge of the functions of the body, and that, with regard to these functions, there is scarcely any fundamental truth which has not been established by experiments on dogs. The action of the heart and its nerves, the circulation of the blood, the nature of respiration, the processes of digestion, the chemical changes which the food undergoes in the body, the functions of the kidneys and of the liver, and the action of the internal secretory glands, have all been revealed by such experiments. And, although corroborative experiments have been carried out since on other animals, these would have been in many cases impossible if the principles had not first been established by the use of dogs. If these animals had been excluded from experiment, few of these facts would have been found out, nor would the knowledge and power gained thereby have been applied for the benefit of man.

Why is the use of dogs so essential in medical research? No one will dispute that, to gain a knowledge of living functions, recourse must be had to living animals, and those animals must be such as can be kept in comfort and health within the precincts of a laboratory. The ordinary farm animals are therefore excluded by this fact alone, altogether apart from the difficulties presented, so far as medicine is concerned, by the wide differences which exist between their digestive processes and those of man.

For a vast number of experiments, viz. the greater part of those necessary in research on infective disease, the smaller animals—mice, rats, guinea-pigs, and rabbits—can be employed. In these experiments it is chiefly necessary to decide whether the injection of a given organism or microbial poison is followed by death or survival. As soon, however, as it becomes necessary to analyse the processes occurring in separate organs, *e.g.* the heart, the kidney, etc., it is essential to make use of larger animals, and the limitation mentioned above confines these to dogs and cats. Cats are used wherever possible. But the delicacy of their tissues, the small size of their organs, and the marked differences which exist between their food habits and those of man render it necessary to employ dogs for many important lines of research. Thus it comes about that the greater part of our knowledge of the heart's action, of the production of lymph and the causation of dropsy, of the nature of diabetes, and of the fate of different kinds of food in the body, is owing to experiments on dogs, and would

not have been discovered if the use of dogs had been prohibited.

Though the advances in medicine of recent years have been so marked, much remains to be discovered. If this Bill is allowed to become law, all research in this country into such problems as the causes and treatment of diabetes, of Bright's disease, of heart disease, of dropsy, of disorders of the stomach and intestines, and many others, will be hampered to such an extent that progress in our knowledge will come to an end, except in so far as it can be attained by observations and experiments on human patients themselves.

A prohibition of the use of dogs would be equally disastrous for the progress of surgery. The fundamental advances made during the last twenty years, which have proved of such inestimable value not only in civil practice, but also during the war in the treatment of our wounded soldiers, were achieved in the first instance by means of experiments on dogs. By such experiments it was first shown to be possible to excise portions of the alimental canal, to make openings from one part to the other in order to relieve obstruction, to remove part or the whole of the internal organs, to implant bone and tissues so as to restore defects, to deal fearlessly with the cavity of the chest, to sew up wounds in the living and beating heart, to restore continuity of wounded blood-vessels, and to perform many others of the feats which are the triumph of modern surgery.

Much more remains to be achieved in order to abolish or alleviate even a fraction of the pain and suffering which are all around us. But all activity in this direction would be hampered, and much of it brought to a standstill, if the Dogs' Protection Bill is allowed to become law.

Nor would the Bill diminish by one jot any pains at present suffered by dogs. Under the law as it at present stands, the infliction of pain on dogs is already prevented. According to the regulations now in force, the animal has to be under the full influence of an anæsthetic during the whole operation, and to be killed before recovering consciousness. Or, if the object of the experiment requires that the dog should be allowed to survive, it must be at once killed under an anæsthetic should pain supervene at any time after the operation.

These regulations can be justified on purely scientific grounds, since the existence of pain during an experiment is a disturbing factor, which is not only an unnecessary complication, but may also vitiate the whole result of the experiment. The only effect of the Bill, therefore, so far as dogs are concerned, would be that a few more of the stray and homeless dogs that are now used for experiment would be added to the 20,000 or more which are killed by suffocation during each year at the Dogs' Home at Battersea.

We cannot believe the Government is so indifferent to the advancement of medical science and the human suffering which it aims at alleviating that such an act of folly as is contemplated in the Bill now under consideration will be permitted to be placed on the Statute Book because of the importunity of certain private members who disregard all that scientific knowledge of disease has to tell them. The Bill is down for the Report stage on May 23, and we look to Ministers to exert themselves sufficiently on that day to protect us from such a pernicious measure.

SIR WILLIAM CROOKES, O.M., F.R.S.

THE few remaining British men of science whose memories extend back to 1862, in reviewing that long period of the past, never lose from the mental vision one remarkable figure. The occasion of the International Exhibition in that year afforded an opportunity by which a young English chemist sprang into sudden fame. The discovery of a new element, however remarkable its properties, would, perhaps, not have proved sufficient to rouse the interest of a mid-Victorian public, but the method of spectrum analysis used in its discovery being then new, coupled with the award of a medal to the exhibit, brought thallium and its discoverer very prominently into notice. The great scientific career thus begun nearly sixty years ago is now closed by the death of Sir William Crookes on Friday, April 4, not only full of years and honours, but also busy in the laboratory to the last.

Crookes was born on June 17, 1832. At an early age he entered as a student at the newly instituted Royal College of Chemistry in Oxford Street, where he remained for some years under Hofmann as demonstrator and assistant. Here he found an atmosphere favourable to the development of his talent for investigation, but it is remarkable that the study of organic chemistry, the chief direction followed by Hofmann and his pupils, never seemed to attract him specially, and many years afterwards he was not ashamed to confess an almost entire ignorance of the work which had occupied so large a number of chemists, especially after Perkin's discovery of the dyes and the general adoption of Kekulé's theory of benzene. His earliest paper records his discovery of the seleniocyanides in 1857, and he was then occupied for a time by the developments then taking place in the processes of photography. The discovery of thallium by the application of the spectroscope gave him occupation for several years, but after completing the study of that element and its compounds it became evident that his preference lay in the direction of phenomena outside the range of ordinary chemical investigation, and that his researches would be pursued along no conventional lines. In passing, it ought to be mentioned that he was instrumental in securing the application of the powerful disinfectant properties of carbolic acid or phenol during the disastrous spread of the cattle plague in 1866.

Meanwhile, Crookes was hard at work on facts

of his own discovery relating to attraction and repulsion accompanying radiation, and in 1873 he astonished the world by the invention of the radiometer. Probably no discovery within our time has given rise to more speculation or has led to a more remarkable development of ideas connected with radiation, and though Crookes did not furnish the true explanation of his instrument, he contributed a large number of experiments which assisted in its ultimate recognition.

From the phenomena shown by the radiometer was an easy step to the study of electrical discharges in high vacua, and henceforward his work on what he called "radiant matter" furnished the starting-point for many of the famous discoveries by others which have led to a completely new field of physics and an utterly novel view of the ultimate constitution of matter. Crookes's study of the rays from the cathode in a vacuum tube in which the gas was rarefied beyond a certain limit led him to consider that the flying particles represented an ultra-gaseous condition which he regarded as a fourth state of matter. This view, which at the time was rather unfavourably received, has been completely justified by further investigations, though his idea of the mass of the radiant particles has had to be modified.

About 1885 Crookes became interested in the phosphorescent spectra of solid bodies, and especially in those of the so-called rare earths. This led him to engage in very lengthy series of experiments on fractionation, and attempts at the resolution of mixtures of these substances into their constituents, and so he was led into the conception of what he called *meta-elements*. He supposed that some oxides, like yttria, might consist of molecules so nearly alike in properties and mass as to be indistinguishable from one another, and inseparable by any known process. Accordingly, these substances were represented in the periodic scheme of the elements as clustering into groups near to certain values of atomic weights. Crookes also devised a spiral model which has become very familiar for displaying the relations of the elements to atomic weight in connection with the periodic law and for illustrating his own views as to the "genesis of the elements." The definition of the term "element" in chemistry, and the characterisation of the recognised elements, formed the subject of his two presidential addresses to the Chemical Society in 1888 and 1889.

During the subsequent thirty years of his life Crookes was much occupied with further experimental work on questions cognate to these subjects. His familiarity with spectroscopy enabled him to pursue successfully an inquiry into the preparation of eye-preserving glass for spectacles, the results of which were published in the Philosophical Transactions so recently as 1914, and have led to valuable practical results, especially in the case of workers in glass and others exposed to furnace glare. The primary object was to find a glass which will cut off as much as possible of the heat radiation, but the experiments were extended to the search for glasses opaque to the ultraviolet. More than three hundred different glasses were investigated, and the compositions of nineteen which have been proved useful are given in the memoir.

It would be impossible in the short space at our disposal now to complete the list of Sir William Crookes's various spheres of activity, but mention must not be omitted of some of his publications. In 1859 he started the *Chemical News*, of which he continued to be proprietor and editor to the end of his life. His famous British Association address at Bristol in 1899 on "The Wheat Problem" attracted for many years considerable attention from economists and agriculturists, and his visits to South Africa in 1896 and in 1905 led to the publication of a small work on diamonds, which has had a large circulation. To these may be added the volume entitled "Select Methods in Chemical Analysis," which is full of useful information, and has passed through four editions, as well as several other books of a technical character.

Crookes was a man of extraordinary genius and immense physical activity, of which his copious published work is evidence. A man of his temperament and his remarkable independence of view in regard to the range of scientific inquiry and the proper attitude of the scientific investigator would naturally be led to look attentively at subjects of all kinds, some of which might be regarded as suspect by other people. It is, of course, well known that he took part in many inquiries concerning psychic phenomena, and that he published a book on spiritualism, in which he recorded certain experiences of his own. These, however, are subjects on which there is too much difference of sentiment and of opinion to be further considered now; they must be left to be handled by the biographer. All that the scientific world now feels is that it has lost a great pioneer worker in the field of natural knowledge.

It is needless to add that honours of all kinds fell thick on Crookes. He was elected into the Royal Society in 1863, and the Royal, the Davy, and the Copley medals were awarded to him by the society, of which he finally became president. He also served as president of several other societies, including the Chemical Society, the British Association, and the Institution of Electrical Engineers. He received a gold medal and a prize of 6000 francs from the French Academy of Sciences in 1880, and in 1899 the Albert medal of the Royal Society of Arts was awarded to him. The Order of Merit was conferred on him in 1910.

It may be of interest to some readers of NATURE to be reminded that in the series of "Scientific Worthies" issued by this journal was published on November 7, 1907, an appreciation of Crookes's scientific work from the pen of a distinguished physicist, Prof. P. Zeeman, of Amsterdam, which affords an estimate of the value of his work by a highly competent authority.

W. A. T.

NOTES.

We much regret to record the death on April 2, at sixty-three years of age, of Sir James MacKenzie Davidson, the distinguished ophthalmic surgeon and radiologist. Sir James Davidson received his early education in Buenos Aires. He came to England as a youth, and entered for medicine at Aberdeen University. He also studied at Edinburgh and London. After graduation at Aberdeen in 1882 he became first assistant to the professor of surgery there, and later lecturer on ophthalmology. He was also ophthalmic surgeon to the Royal Infirmary, Aberdeen, and the Royal Sick Children's Hospital, and physician to the Blind Asylum. The experience gained as an ophthalmic surgeon in Aberdeen exercised a great influence on his work when he came to London. In 1896 Röntgen's discovery of X-rays was announced, and with characteristic energy and commendable foresight Sir James Davidson at once grasped the significance of this discovery in relation to medicine. The same year found him making a pilgrimage to Würzburg to interview Röntgen. After removing to London in 1897 he became radiologist to Charing Cross Hospital and to the Royal London Ophthalmic Hospital. At a later date he became consulting radiologist to both these institutions. Henceforth Sir James Davidson's whole energy became absorbed in research work, and he quickly took a leading position amongst the pioneer workers in X-rays and radium. His early training in ophthalmology led him to grasp the value of X-rays in this branch of medicine, and particularly in the localisation of foreign bodies in the orbit and eyeball: the method elaborated by him, and always associated with his name, became recognised as the standard one, and upon it all the modern methods are based. He also advocated the practice of stereoscopic radiography. He received a knighthood in 1912, and at the time of his death held the positions of past-president of the Röntgen Society and honorary consulting radiologist to the London District Command. The development of radiodiagnosis and radiotherapy are intimately bound up with the name of MacKenzie Davidson, and he was recognised in America and on the Continent as the leading radiologist in this country. By his death radiology has lost a distinguished exponent of technique, an original worker of the highest order, and an enthusiastic advocate of its future in medicine and science.

We regret to learn that Dr. William Allen Sturge died on March 27 in his sixty-ninth year. Dr. Sturge was born in Bristol, and graduated as M.D. in the University of London, but spent the greater part of his professional life at Nice, where he was a highly esteemed medical practitioner. While on the Riviera he devoted much of his leisure to collecting and studying ancient Greek vases and other objects of Greek art, and eventually extended his interests to prehistoric archæology. He collected flint implements from the French caves and other Continental localities, and on his return to England in 1907 he chose his residence at Icklingham, Suffolk, where he could explore one of the richest districts for flint implements in this country. He also acquired specimens from the collections of William Greenwell, Worthington Smith, Allen Brown, and others. Dr. Sturge contributed several papers to the Proceedings of the Prehistoric Society of East Anglia, of which he was one of the founders and first president in 1908. He also did much to advance our knowledge of the Stone age by his stimulating help to fellow-workers. Dr. Sturge's great collection of stone implements is bequeathed to the British Museum.

We learn from the *Biochemische Zeitschrift* that Prof. R. Kobert died at Rostock on December 27, 1918, at sixty-four years of age. Prof. Kobert had taught pharmacology, physiological chemistry, and the history of medicine and pharmacy in the university of that town since 1899. After having studied medicine at Halle he became assistant to Schmiedeberg at Strasburg in 1882. The latter's pharmacological institute, founded a little earlier, was at that time the only laboratory of its kind in Germany, the others being at Dorpat and Vienna. In 1886 Kobert succeeded Buchheim as professor of pharmacology at Dorpat, where Dragendorff then was professor of pharmacy, but the Russification of the university in 1897 terminated the work of its German teachers, including Kobert. The deceased was a prolific author of compilations on pharmacology, toxicology, etc., and of papers on ergot, the saponins, the vegetable hæmolysins, and other subjects.

Sir Auckland Geddes, Minister of National Service and Reconstruction, has resigned his office, and will return to McGill University, Montreal, where he will succeed Sir William Peterson as principal. He was professor of anatomy at the University when the war broke out, and stipulated, on accepting the chair, that in the event of hostilities he should be at liberty to resign without notice. His connection with the University was not, however, broken; for the governors did not accept his resignation, and he has been on leave from his chair throughout the war. When he became Minister of National Service it was on the understanding that he should be free at the end of the war to devote his life to politics or return to university work. The Prime Minister has testified that Sir Auckland Geddes's work during the war "has been of inestimable value to the country"; and, as principal of McGill University, his services to scientific education and advancement are likely to have an equally strong influence upon the destinies of the Dominion and the Empire.

Dr. E. J. Russell has been elected a foreign member of the Royal Swedish Academy of Agriculture, Stockholm.

Mr. R. A. Gregory has been elected a member of the Athenæum Club under the provisions of the rule of the club which empowers the annual election by the committee of "a certain number of persons of distinguished eminence in science, literature, or the arts, or for public services."

The death occurred on April 2, at eighty-seven years of age, of Dr. Edward Liveing, emeritus registrar of the Royal College of Physicians of London, and the author of a volume on "Megrim: A Contribution to the Pathology of Nerve Storms."

According to the *Münchener medizinische Wochenschrift*, the Griesheim-Elektron Chemical Works now manufacture an almost pure calcium hypochlorite under the name "hyporit." This contains 80 per cent. of available chlorine (as compared with 36 per cent. in the best bleaching powder), and is a stable white powder dissolving readily in water to a very faintly alkaline solution, which can be used instead of Dakin's solution for the irrigation of wounds and for other purposes. The impurities are a small quantity of calcium chloride and very little lime. This is the first stable solid hypochlorite manufactured on a large scale.

A Red Cross Conference is now being held at Cannes. On April 5 the delegates, presided over by Dr. Herman Biggs, Public Health Commissioner, New York State, discussed the desirability of setting

up immediately a Central Health Bureau with the view of linking up the various national Red Cross societies in a health crusade throughout the world. The proposal was very favourably received, and was supported, among others, by Sir Robert Philip (Edinburgh), Profs. Baduel (Florence), Roux (Paris), Kenwood (London), Sir Ronald Ross, Col. Cumming (U.S. Public Health Service), and Prof. Kabishima. Such subjects as standardisation of nursing methods and the training of nurses, training of public health *personnel*, combating tuberculosis, as well as the promotion of research, were considered by the various speakers to come within the limits of such a crusade.

WE are glad to note that vigorous protests have been raised in the *Times* against the suggestion, emanating from Toronto, that aeroplanes should be used for the purpose of driving caribou by the thousand into corrals, where they might conveniently be slaughtered. The carcasses thus obtained were to be used for increasing the meat supply of Canada and for export. If such a scheme were ever sanctioned the caribou would speedily share the fate of the American bison. The further suggestion that airmen might destroy wolves and feral dogs by machine-gun fire does not sound very practicable, but these deadly weapons could, and probably would, be used against the caribou. It is devoutly to be hoped that no more will be heard of this proposal, which has given offence to all true sportsmen, as well as to those who are concerned with the conservation of wild animals.

IN this first Easter vacation after the cessation of hostilities the Port Erin Biological Station is almost as fully occupied as in pre-war days. About fifty researchers and senior students are working there some time during the latter part of March and April, including four professors and half a dozen demonstrators, with groups of students from London, Manchester, Liverpool, Cambridge, and Reading. Prof. Benjamin Moore, with three other biochemists, is engaged on a research on photosynthesis in relation to the alkalinity of the sea. Most of the others are on faunistic or morphological work. Fortunately, the weather has been favourable for work at sea, and for shore-collecting during the low spring tides. In the plankton the vernal phytoplankton maximum has appeared. Coscinodiscus has been in abundance during the latter part of March, and now Chætoceras is in evidence. The Manx summer herring have made their appearance close inshore unusually early; a few hundred may be caught any night in Port Erin Bay, but a more notable catch of half a dozen mease was secured a few miles along the coast on one of the first nights in April.

"THE Function of Science in the Modern State" and "National Life from the Standpoint of Science" are the subjects of two papers contributed some years ago by Prof. Karl Pearson to the Eugenic Lecture Series (Cambridge University Press). Prof. Pearson has done well to republish these papers in view of the altered circumstances of the nation since the war and the necessity for recognising as soon as possible a better theory of the State than was previously available, especially for the employment of scientific method in the organisation of every department of business, of administration, of education, and of progress in invention and discovery. The executive must be freed from the dominance of minds trained solely on literature and jurisprudence, for in the future the struggle for existence will not necessarily be settled in favour of the biggest or the richest or the best-armed nation. Everything will be determined by organisation of the brain-power which the nation possesses, and by teaching the leaders, as well as the people at large, to prepare for the difficulties of new environment. Prof. Pearson discusses these problems in an interesting way from the point of view of eugenics and the principle of evolution. Hence he lays great emphasis on the importance of preventing so far as possible deterioration as the result of deficient reproduction among the intellectual classes and encouragement of the inferior stocks. In these two pamphlets there is much food for thought for every man and woman, and they should be read by everybody.

A CONSIDERABLE change is made in the Daily Weather Report of the Meteorological Office from April 1. During the war the weather information expanded, and was more complete than in pre-war times; the information, however, was not supplied to the public, but it was widely distributed to the Services and eagerly used. Since the freeing of weather information, subsequent to the armistice, some idea could be formed by the public of the increased activity of the Weather Office. The change now effected is, in a measure, very drastic. Instead of the Daily Weather Report containing home and foreign stations, with maps for each hour at which observations were made, there are now three separate reports: the British Section, the International Section, and the Upper Air Supplement. The British Section and the Upper Air Supplement are issued in lithographic form in the forenoon of the day's observations, and the International Section is issued early on the following day. The British Section gives detailed observations from observatories of the Meteorological Office and stations of the Air Ministry for 1h., 7h., 13h., and 18h., and other Meteorological Office stations for 7h. and 18h., previously included in the Daily Weather Report. It also gives a full-page weather-map, including Iceland, the Azores, and a large part of western Europe, also forecasts for the twenty-four hours commencing at 3 p.m. for twenty districts covering the British Isles. The Upper Air Supplement gives maps of the British Isles with winds at the surface and at elevations of 1000, 2000, 5000, 8000, 10,000, and 15,000 ft. for afternoon, evening, and morning. The International Section practically covers western Europe and the Mediterranean with observations for evening and morning, and there are two full-page weather-maps. Provision is made for wireless reports from the Atlantic.

A MEMORANDUM on the share of "colonies" (institutions for training and for employment) in the treatment of tuberculosis by Mr. J. E. Chapman has been issued by the Local Government Board (Reports on Public Health and Medical Subjects, No. 122). Colony treatment is intended to secure for selected patients beneficial results of a more lasting nature than can be obtained by sanatorium treatment alone. In the earlier colonies the work provided was mainly of an agricultural character, but as few patients continue this occupation after discharge, more recently established colonies aim to fit the patient for an occupation that will be continued. The whole subject is adequately considered in this memorandum, which is illustrated with figures of two types of cottage homes suitable for a colony.

"THE Lessons of the War and Some New Prospects in the Field of Therapeutic Immunisation" was the subject of an important lecture by Sir Almroth Wright delivered before the Royal Society of Medicine on February 25 (see *Lancet*, March 29, p. 489). The natural defences of the body against, and in the presence of, infections were fully dealt with, and a number of ingenious experiments detailed in confirma-

tion of the views expressed. The anti-tryptic power of "wholesome" blood and the leucocytes are the great defensive mechanisms, and the treatment of septic wounds should aim at bringing these into action. A method of "immuno-transfusion" for the treatment of septic wounds was also described, in which blood from a donor is, after withdrawal, first allowed to act upon and digest a given quantum of the infecting micro-organism, after which the treated blood is injected into the patient.

A report by King Edward's Hospital Fund for London on "Pensions for Hospital Officers" has been issued. The inquiry was held by a sub-committee consisting of Mr. W. J. H. Whittall, Mr. H. L. Hopkinson, and Sir William Collins. The final recommendation of the first two members is that pensions should be provided by means of insurance policies paid for by joint contributions of employers and employees, much on the lines of the Federated Superannuation scheme for University colleges. Sir W. Collins dissents on the ground that a scheme based on recourse to insurance companies is not the only possible solution of the problem, and that alternative schemes should be considered at a conference of hospital representatives which it is proposed to summon to discuss the whole question.

Ornithologists who are interested in migration will read with interest in *British Birds* for March some observations by Mr. D. G. Garnett on birds seen in the north-eastern Atlantic and the English and St. George's Channels from August to October, 1917. It has been definitely established that there is a route followed by migrating birds which extends down the western Irish coast, across the approaches of St. George's Channel and the English Channel, to the north-west of France. It is now suggested by Mr. Garnett that, as a consequence of his observations, there seems evidence to show that there is yet another route traversing this, and extending from the south coast of Ireland to the west coast of Spain.

The food habits of the mallard ducks of the United States forms the subject of a very valuable Bulletin (No. 720) issued by the United States Department of Agriculture. The author, Mr. W. L. McAtee, set himself the task of discovering the food preferences of these birds for the purpose of obtaining information which could be put to good purpose in establishing wild-duck farms and increasing the stock of wild birds on account of their great value as food. Though mainly vegetarian, Mr. McAtee points out the extreme value of these birds as exterminators of mosquito larvæ. Experiments on enclosed water with captive birds showed that in this regard they are far more effective than goldfish, which were used in a control experiment. Hence, he remarks, these birds are of incalculable value in keeping down mosquitoes in swamps that would be extremely costly to drain.

An interesting summary of suggestions as to the best means of rapidly increasing the produce of food-crops in India by methods within the power of the Agricultural Department has been issued (Bulletin No. 84) by the Agricultural Research Institute, Pusa. The bulletin consists of a collection of notes submitted by representatives of the Department in various parts of the country, and, although there is naturally considerable variety in the specific proposals for the individual areas, it is interesting to note a general agreement that the most effective means of securing a rapid increase in the output of food-crops lies in the dissemination of improved strains of seed. For Bengal alone it is estimated that the substitution of the pure line *Indrasail* developed by the agricultural station at Dacca for the local varieties of transplanted rice commonly used would lead to an increase of 500,000 tons of rice. Similar improvement of the rice crop is also being effected in the Central Provinces, Madras, and Burma. In the Punjab special attention has been directed to wheat, and two varieties which have been found to give from half a maund to three maunds per acre more than local varieties are now being extensively developed. Similar improvements in wheat output are also being effected in the Central Provinces. In many of the reports emphasis is placed upon the improvement which might be effected by better methods of cultivation alone, and by more active participation of the large landowners in the cultivation of their land. More abundant and efficient irrigation is also emphasised as a special need of certain areas. There would appear to be little prospect of increase, however, by the use of manures or by the substitution of food-crops for fibre or other non-food producing crops.

We have received a copy of a booklet entitled "Decimal Coinage and British Commerce," by Mr. J. Gall Inglis. The author advocates a decimal system of coinage alternative to that proposed in the Bill which was introduced in the House of Lords last year. His scheme involves the decimalisation of the shilling and half-sovereign, instead of the sovereign, while retaining the latter as a coin, but not as a unit. The shilling would remain as at present, but the new penny would be one-tenth of a shilling, and divided into ten "mils." Mr. Inglis points out that for business purposes it is necessary to take into account the relative amount of clerical work involved in our present system and in the proposed decimal schemes, and he has constructed a table showing that the amount of figure-writing with the decimal half-sovereign would be less than is now necessary, and considerably less than with the decimal sovereign. He urges the importance of preserving the shilling as the indispensable pricing unit. A short account is also given of a scheme for decimalising our weights and measures on a metric basis. The booklet, which is published by Messrs. Gall and Inglis, Henrietta Street, Strand (price 1d.), is noteworthy for its original and practical outlook, and will appeal to those interested in the question of decimalisation.

In 1917, for the first time, the annual meeting of the Indian Association for the Cultivation of Science was divided into a business meeting held in September and a science convention held in November. According to the report of the association for 1917, recently received, the division proved an unqualified success. Nine physical, four chemical, and seven biological papers were read at the convention by the staff and students of the association, and they constitute, with the report, a volume of more than 150 pages. The association is doing much to encourage research in India, and the conditions of appointment of their professor of physics will serve as a good example to many institutions in this country. He is required (1) to devote himself to original research in his subject, (2) to stimulate and guide research by advanced students, (3) to superintend the formation and maintenance of the physics laboratory, and (4) he is under no obligation to share in the teaching of the M.A or M.Sc. classes of the university. This professorship is held by Prof. Raman, while Sir P. C. Rây holds the corresponding one in chemistry.

The February issue of the Journal of the Chemical Society contains an interesting paper by Mr. R. Wright on "The Effect of some Simple Electrolytes on the Temperature of Maximum Density of Water." The author confirms Despretz's law that the lowering

of the temperature of the point of maximum density of water caused by the addition of a solute is directly proportional to the concentration of the latter. Mr. Wright further shows that the lowering of the temperature of the maximum density of water produced by a highly ionised binary electrolyte is composed of two separate independent effects, one due to the acid and the other to the basic radicle, and can therefore be calculated by the addition of two moduli to the lowering produced by a molecular solution of a chosen standard substance. The standard substance chosen was normal hydrochloric acid. The acid salts of the dibasic acids behave normally, but the neutral salts and the salts of bivalent metals do not conform to any simple rule in their effect on the temperature of maximum density. The feebly ionised organic acids show abnormal effects, but their highly ionised salts behave in the normal manner.

CONSIDERABLE interest is attached to the comparatively rare alkaloid hyoscine or scopolamine, owing to its use in the treatment popularly known as "twilight sleep." The hyoscine of commerce, extracted from solanaceous plants, is lævorotatory, but an optically inactive form produced by the action of dilute alkali on the naturally occurring alkaloid is known. At a meeting of the Chemical Society on April 3 Mr. Harold King, of the Wellcome Chemical Research Laboratories, described the resolution of this optically inactive hyoscine into the well-known lævo- form and the hitherto unknown dextro- form. On hydrolysis *l*-hyoscine yields *l*-tropic acid and an optically inactive amino-alcohol, oscine. Mr. King has also resolved the latter into its optically active components. Since, therefore, tropic acid and oscine each contain an asymmetric carbon atom, and are each capable of existing in three forms, two active and one inactive, the possible combinations of these various forms may give rise to ten, or possibly eleven, isomeric hyoscines. It becomes of interest to ascertain which of these forms are represented by the two optically active hyoscines already known. This question is still under investigation, but Mr. King pointed out that as benzoyl *d*-oscine gives optically pure *d*-oscine on hydrolysis, it seems probable that the known hyoscines contain inactive oscine, the optical activity being due to the lævo- and dextro-tropyl radicles respectively.

ON taking over the duties of the chair of metallurgy in the Royal Technical College, Glasgow, last September, Prof. Cecil Desch devoted his introductory lecture to a review of the aims of a Glasgow School of Metallurgy. In this address Prof. Desch laid emphasis upon a change in the methods of industry which has recently been taking place. He quoted from Prof. Patrick Geddes, who has proposed to divide the industrial age into two periods, which he has called the "palæotechnic" and the "neotechnic." In the earlier of these the aim of industry was merely the accumulation of material wealth. Natural resources were squandered recklessly, the one consideration being their rapid conversion into marketable products. Human life was disregarded, the cheapest labour being utilised without reference to the standard of life. In England this was essentially the age of coal. Fuel was cheap and abundant; no care was exercised in its use, and our scenery was disfigured by smoke as the manufacturing districts spread over the country. Housing conditions were such as to accommodate the largest number of persons on a given area at the lowest possible cost, and the results are to be seen in the squalid industrial regions of Manchester, Sheffield, the Black Country of the Midlands, and Glasgow. It is, however, being slowly realised, both by the employers of industry and the workers themselves, that all natural resources must be used with the utmost economy, unnecessary destruction avoided, health and comfort considered in the devising and planning of works, and the erection of squalid dwellings crowded into a minimum of space must give place to town-planning on a scientific and sound basis. The symbol of the palæotechnic age was the furnace fired with raw coal; that of the neotechnic age is the electrical power-house with its clean atmosphere and white-tiled walls. Prof. Desch is to be commended on having laid such emphasis on a matter of vital importance to the future of the country.

COPIES have reached us of Nos. 2 and 3 of the *Children's Newspaper*, a weekly periodical edited by Mr. Arthur Mee, and published by the Amalgamated Press, Ltd. Mr. Mee was editor of the "Children's Encyclopædia" and "Harmsworth's Popular Science," both of which are among the best works of their class. The new periodical shows the same interest in scientific matters and originality in presenting them to juvenile readers. Its aim is to give "the story of the world to-day for the men and women of to-morrow," and we are glad to see that the world includes Nature as well as man. We should like to think that when the boys and girls who now derive pleasure and profit from the newspaper published especially for them become adults they will expect like fare to be provided in the public Press. The *Children's Newspaper* will be a valuable aid in this direction, and we cordially welcome it.

Messrs. A. and C. Black, Ltd., will publish shortly a book on "Cerebro-spinal Fever," by Drs. C. Worster-Drought and A. M. Kennedy. The authors were responsible for the treatment of the disease among the troops in the Woolwich military district. The following works have been arranged for appearance in the University of Chicago Science Series (*Chicago: The University of Chicago Press; London: The Cambridge University Press*):—"Black Body Radiation," Prof. C. E. Mendenhall; "Mechanics of Delayed Germination in Seeds," W. Crocker; "The Rigidity of the Earth and of Materials," Prof. A. A. Michelson; and "Linear Integral Equations in General Analysis," E. H. Moore. The new list of *Messrs. Longmans and Co.* includes "The Design of Propellers for Aircraft," H. C. Watts; "The Design of Aero Engines," Major A. T. Evans and Capt. Adams; "Engineering Machine Tools and Processes," A. G. Robson; "The Principles and Practice of Electrical Testing," R. G. Allen; and "Garden First in Land Development," W. Webb. *Mr. H. Milford* announces "The Place of the University in National Life," the Right Hon. H. A. L. Fisher (No. 4 of "Barnet House Papers").

THE latest catalogue (No. 387) of Mr. F. Edwards, 83 High Street, Marylebone, W.1, appears at an opportune moment, seeing that it deals with books relating to Europe. It is historical and descriptive, and conveniently arranged according to the various countries of the Continent. Doubtless it will be of interest to many readers of NATURE at the present time. Copies are obtainable upon application.

OUR ASTRONOMICAL COLUMN.

THE APRIL METEORIC DISPLAY.—The shower of Lyrid meteors in April dates from antiquity, and some of the early displays appear to have been of an exceptional and striking character. In 1803 a brilliant exhibition was witnessed in America, and in 1851 it was repeated in Indian skies. In 1863 its visitation as viewed from England was conspicuous, if it lacked the grandeur of old-time spectacles. It is evidently not a phenomenon with attractive features which we can await with confidence every year as in the case

of the August Perseids. It is rather an event with possibilities which cannot be definitely predicted because it is affected by irregularities not fully understood. Usually it must be confessed that the shower provides few meteors and disappointment. However, meteoric astronomers anticipate its brilliant revival at any time, and watch the spring skies with a keenness which merits success.

The meteors are due on the night of April 21, when the moon will be at her last quarter, and does not rise until nearly an hour after midnight. But it will be advisable to watch on the preceding night also, and the hours after midnight are likely to be the most productive, the radiant point at $271^\circ+33^\circ$ being at a much greater altitude than in the evening hours. The really active stage of the shower is limited to a few hours, but the whole duration is much longer, and certainly extends from April 18, when radiation is from $266^\circ+33^\circ$, to April 26, when it has advanced to $278^\circ+33^\circ$.

Unification of the Astronomical and Civil Day.—The Lords Commissioners of the Admiralty have given instructions to the Superintendent of H.M. Nautical Almanac Office that in the Almanac for 1925 the day shall be considered as beginning at midnight, to make the astronomical agree with the civil day. This change has been resolved on after consultation with the Royal Astronomical Society, which issued a circular to the superintendents of the ephemerides of other nations and to the representatives of other bodies asking for opinions and suggestions. It appears that the change is to be made chiefly in the interests of seamen, who will find it more convenient to have the same time system in use for purposes of navigation and for ordinary life on board ship. It may be remembered that a vigorous attempt to secure this unification of the civil and astronomical day was made about the year 1885.

The Evolution of Binary Systems.—Mr. J. H. Jeans, in the Monthly Notices of the Royal Astronomical Society for December, 1918, examines some of the problems of double-star orbits. While in the solar system the angular momentum is too small for the system to have broken up through rotation, in the majority of binary systems it is too large for this to have happened. Tidal action cannot increase the latus rectum by more than some 60 per cent. in the case of equal masses (Russell). Large alterations of latus rectum, and hence of period, cannot, therefore, arise from the mutual action of the stars. Either the periods have retained approximately their present values throughout the star's career (this hypothesis is rejected), or there must have been sensible disturbances from other stars. This leads Mr. Jeans to the interesting conclusion that the stellar system was initially of about 1/1000 of its present volume. He suggests that the outward movement may still be in progress, and notes the observed excess of positive radial velocities as evidence of this. In its earlier compressed condition mutual encounters of stars would have been frequent. Incidentally, he finds 0·637 as a mean value of eccentricity of orbits as produced by encounters. This accords well with observed facts.

It is advisable to direct attention to one sentence of the summary. Mr. Jeans says:—"The dwarf M stars have velocities which show no preference for particular directions in space, and there seems to be no correlation between the magnitude of their velocities and the parts of the universe they occupy." But, in fact, we are acquainted only with those dwarf M stars that are in close proximity to the sun; for such stars are intrinsically so faint that they do not appear in our catalogues at all if they are distant.

AERIAL PHOTOGRAPHY.

PHOTOGRAPHY from the air reached a wonderful degree of excellence during the war, as is demonstrated by the pictures that have been published and shown at various exhibitions; but for obvious reasons the instruments used for this work have only quite recently been made public. The experts who have compared the various lenses suitable assure us that those made by English opticians were found to be not only equal to those of Zeiss and Goerz, but markedly superior to them. With regard to cameras, the editor of the *British Journal of Photography* has had an opportunity of seeing the whole range of cameras used by the Royal Air Force, and describes them in an article in his journal of March 21. Within a few months of the beginning of the war the value of aerial photographs began to be recognised, and specially made cameras were first used early in 1915. The first camera was of a very primitive type, and fitted with a Mackenzie-Wishart adapter for 5×4 plates. Early in 1916 a magazine-changing arrangement was used with the plates in metal sheaths, the foremost—that is, the lowest—plate being pushed sideways after exposure into the receiver by a horizontally moving metal plate. So far the cameras were of wood, but in 1917 a metal camera was introduced, and the changing done by pulling a cord instead of pushing a metal plate.

The next improvement (early in 1917) was to provide a mechanical method of changing, the motive power being produced by a small propeller, which was brought into action by simply releasing a Bowden lever, the shutter being automatically actuated at the same time and by the same means. In 1918 this camera was further improved in several ways. The shutter was made replaceable by another, if necessary, as on account of derangement, and lenses of focal lengths from 4 in. to 20 in. might be used on the same camera. Among other patterns was one, first used in 1916, which would take a continuous series of photographs, up to 120, on a roll of film. The exposures were made automatically at intervals corresponding with a certain number of revolutions of the propeller, and by means of a small supplementary lens each negative had recorded on it the height of the machine and its compass bearings. Major C. W. Gamble, of the R.A.F., in a lecture before the Optical Society on March 13, after describing the various cameras used, said that, although the most rapid plates were desirable so that exposures might be made late in the day and when the light was poor, it was found that the density-giving capacity of the plate was of at least equal importance. As time progressed the tendency was to use panchromatic rather than orthochromatic plates, and, finally, three-fourths or more of the plates used were panchromatic, a suitable light-filter being employed.

NEW KNOWLEDGE OF A PUZZLING GROUP OF GYMNOSPERMS.

THE abundance of large fronds in Rhætic, Jurassic, and Wealden rocks, closely resembling in habit those of some recent Cycads, and the occurrence of hundreds of petrified trunks in Jurassic and Neocomian strata in North America and, in smaller numbers, in many other parts of the world, have led palæobotanists to speak of these periods as the "age of Cycads." It is, however, a remarkable fact that the reproductive shoots of these Cycad-like plants differ very widely from the corresponding organs in the true Cycads; had we possessed no knowledge of the vegetative organs, the reproductive shoots would

not have been styled cycadean. The differences between the reproductive organs of the recent and extinct forms find expression in the reference of the Jurassic and Lower Cretaceous plants to a separate group, Bennettitales, the existing cycadean genera being included in the Cycadales.

Dr. Marie C. Stopes has recently made two important contributions to our knowledge of the Bennettitales in a paper published in vol. ccviii. of the Philosophical Transactions of the Royal Society, containing descriptions and many admirable illustrations of a new species of seminiferous cone and a cone-bearing stem. The new cone, named *Bennettites albianus*, was discovered in the Gault of Folkestone by Mr. G. C. Walton. A French specimen of Bennettites was described some years ago by Prof. Lignier from beds in Normandy, believed by him to belong to the Gault, but with that exception all Bennettitean cones are from Jurassic or Wealden strata. The preservation of the English species is unusually good; the type-specimen is a portion of the broad domical apex of a cone about 120 mm. in diameter, containing several hundred seeds, many of them with embryos. In general plan it agrees with previously described Bennettites cones; each seed is closely invested by seven interseminal scales, with expanded and laterally confluent truncate apices, forming a strong protective covering to the surface of the "fruit." It is suggested that the lacunar tissue surrounding the stalks on which the erect exalbuminous seeds are borne, and the tubular cells of the arillus-like basal cup in which each seed is embedded, drew up and retained water like the water-storage tissue of a bog moss, thus keeping the interior of the fruit moist. It is pointed out in support of this ingenious view that the seeds are deficient in vascular-conducting tissue.

The careful and detailed investigation of the complex structure of the seeds does not afford support to the view advanced by some writers that the Bennettitean seed agrees closely with that of Gnetum, nor are any new facts brought to light which favour an alliance between Bennettites and the Angiosperms.

It is probable that the plant which bore the cone described by Dr. Stopes was one of the latest representatives of the Bennettitales; the habit and the anatomical characters of the vegetative organs were, in the main, retained by the Cycads as we know them to-day—a small group, for the most part tropical in their distribution, and probably of comparatively recent origin. On the other hand, it has yet to be shown that the complex reproductive shoots of Bennettites gave rise to any direct descendants.

The thorough examination by Dr. Stopes of the Lower Greensand stem named by Carruthers *Bennettites maximus* shows that it agrees anatomically with other species except in the absence of any undoubted secretory cells in the ground-tissue of the stem and leaf-bases. The abundance of thick-walled, pitted cells, or "transfusion elements," which physiologically may represent secretory cells, is a characteristic feature. The most important point made by the author is that *Bennettites maximus* bore bisporangiate cones similar to those described by Wieland from America, and differing from the apparently unisexual cones previously recorded from Britain.

A. C. SEWARD.

EDUCATION AND SCIENCE IN THE CIVIL SERVICE ESTIMATES.

THE Estimates for Civil Services for the year ending March 31, 1920, amount in Class IV. (Education, Science, and Art) to 41,251,610*l*. The following are among the Estimates:—

United Kingdom and England.

Service	1919–20 £	Compared with 1918–19 Increase £
Board of Education ...	31,353,111	12,243,406
British Museum	209,714	83,572
Scientific investigation, etc.	113,974	59,733
Department of Scientific and Industrial Research ...	242,815	94,465
Universities and Colleges, United Kingdom, and Intermediate Education, Wales	945,700	624,000
Universities, etc., special grants	500,000	470,000
Scotland.		
Public education	4,677,220	1,635,675
Ireland.		
Public education	2,721,356	519,752
Intermediate education ...	90,000	—
Science and art	190,498	27,105
		Decrease
Universities and colleges ...	85,000	11,350

Details of some of these Estimates of particular interest to men of science are as follows:—

SCIENTIFIC INVESTIGATIONS, ETC.

	£
Royal Society:	
(i) Grant in aid of (*a*) scientific investigations undertaken with the sanction of a committee appointed for the purpose (4000*l*.) and (*b*) scientific publications (1000*l*.)	5,000
(ii) Grant in aid of salaries and other expenses of the Magnetic Observatory at Eskdalemuir	1,000
Meteorological Office	47,000
Royal Geographical Society	1,250
Marine Biological Association of the United Kingdom	1,000
Royal Society of Edinburgh	600
Scottish Meteorological Society	100
Royal Irish Academy	1,600
Royal Zoological Society of Ireland	500
British School at Athens	500
British School at Rome	500
Royal Scottish Geographical Society	200
National Library of Wales	8,900
National Museum of Wales:	
Grant in aid of the expenses of the museum	4,000
Special building grant in aid	20,000
Solar Physics Observatory	3,000
School of Oriental Studies	4,000
North Sea Fisheries Investigation	1,250
Imperial Mineral Resources Bureau	11,000
Edinburgh Observatory	1,974

SCIENTIFIC AND INDUSTRIAL RESEARCH.

	£
Salaries, wages, and allowances	11,870
Travelling and incidental expenses	1,500
Grants for Investigation and Research:	
(1) Grants for investigations carried out by learned and scientific societies, etc. ...	13,570
(2) Grants for investigations directly controlled by the Department of Scientific and Industrial Research	55,000
(3) Grants to students and other persons engaged in research	25,000

(These grants will be distributed by a Committee of the Privy Council, on the recommendation of an Advisory Council, to promote the development of scientific

	£
and industrial research in the United Kingdom, and will be subject to such conditions as the Committee may think necessary.)	
Fuel Research Station	12,775
National Physical Laboratory[1]	154,650

UNIVERSITIES AND COLLEGES, UNITED KINGDOM.

	£
University of London	8,000
Victoria University of Manchester	2,000
University of Birmingham	2,000
University of Wales	4,000
University of Liverpool	2,000
Leeds University	2,000
Sheffield University	2,000
Bristol University	2,000
Durham University	2,000
Scottish Universities, grant in aid under section 25 of the Universities (Scotland) Act, 1889,[2] 42,000*l.*; additional grant in aid, 42,000*l.*	84,000
Grant in aid of the University Colleges Grants Deposit Account, to be employed in making grants in aid of certain Colleges in Great Britain giving education of a university standard in arts and sciences and technology	[3] 210,000
Grant in aid of the expenses of the University Colleges of North Wales, South Wales and Monmouthshire, and Aberystwyth (4000*l.* to each)	12,000
Additional grant in aid of the expenses of the University of Wales and of the University Colleges of North Wales, South Wales and Monmouthshire, and Aberystwyth (2500*l.*, 5125*l.*, 7750*l.*, and 5125*l.* respectively) ...	20,500
Grant in aid of the expenses of the Imperial College of Science and Technology ...	32,000
Supplementary grant in aid of maintenance of Universities and Colleges in the United Kingdom	[4] 531,500
Total for Universities and Colleges ...	916,000

SPECIAL GRANTS.

	1919–20 £	1918–19 £	Increase £
Special grants in aid of Universities, Colleges, Medical Schools, etc.	500,000	30,000	470,000

Certain of the universities, colleges, and other similar institutions which are in receipt of Parliamentary grants are in need of special assistance in order that they may, so far as possible, resume their full work under favourable conditions, and may not be hampered by extraordinary expenditure involved by the prolonged interruption of their activities and development caused by the war. The special grants in aid for 1918–19 were provided to meet particularly urgent cases in which some measure of assistance could not be delayed until the conclusion of hostilities without risk of grave permanent detriment to the institutions concerned.

1 Services rendered without payment for other Government Departments are estimated as follows:—Admiralty, 6500*l.*; Air Ministry, 36,350*l.*; Ministry of Munitions, 63,000*l.*; War Office, 500*l.* The testing fees at the National Physical Laboratory and charges for special investigations amounted to 26.500*l.*

2 In addition to an annual sum of 30,000*l.* payable to these Universities from the Local Taxation (Scotland) Account under Section 2 (2) of the Education and Local Taxation Account (Scotland) Act, 1892.

3 Of this amount 60,000*l.* will be devoted to grants in aid of technological education.

4 This sum, together with 84,000*l.* provided in Class IV., 18, is intended to raise to 1,000,000*l.* the total amount of the grants paid out of the Exchequer during the year 1919–20 for the maintenance of University Institutions in the United Kingdom.

UNIVERSITIES AND COLLEGES, IRELAND.

	£
Queen's University of Belfast	18,000
University College, Dublin	32,000
University College, Cork	20,000
University College, Galway	12,000
National University of Ireland and University College, Dublin	1,000
Additional grant towards increasing the resources of University College, Galway ...	2,000

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Cavendish professorship of experimental physics, recently vacated by the Master of Trinity, has been filled by the appointment of Sir Ernest Rutherford. This office carries with it the direction of the Cavendish Laboratory. An adequate continuation of the very remarkable line of occupants of this important position, represented by the names of Clerk Maxwell, Rayleigh, and J. J. Thomson, has thus been secured.

At the same time the University fortunately continues to be in a position to profit by the services of Sir J. J. Thomson on an honorary basis. A special professorship of physics without stipend has been created for him, and accommodation and resources will be provided, so far as finances permit, for the prosecution of his scientific work and his activities in the stimulation of research in physical science.

It is hoped that the University will very soon find itself in a position to embark upon the structural developments which will be required in order to take full advantage of this great accession of strength in the most fundamental of the sciences, and to maintain the repute and activity of the Cavendish Laboratory at the level that the national interest in the coming time will more than ever demand.

LONDON.—The Ramsay Memorial Committee has offered to the University a sum of not less than 25,000*l.* towards the foundation of a laboratory of chemical engineering at University College. The Senate has gratefully accepted the offer, and is allotting a site for the purpose.

ON the invitation of the governors of Birkbeck College, London, Lord Haldane has accepted the position of president of the college, in succession to the late Lord Alverstone.

APPLICATIONS for grants from the Dixon Fund of the University of London for assisting scientific investigations must reach the Academic Registrar of the University before May 15 next.

THE Lindley studentship in physiology will shortly be awarded by the University of London. It is open to students qualified to undertake research. Applications must be made to the Academic Registrar, the University of London, South Kensington, before April 30.

A COMMITTEE of the Royal College of Physicians of London and of the Royal College of Surgeons of England will shortly appoint a Streatfeild research scholar in medicine and surgery. The annual value of the scholarship is about 250*l.*, and the tenure three years, at the discretion of the committee. Applications, stating the nature of the proposed research, the place where it is to be carried out, and the status of the applicant, should be sent to the Registrar, Royal College of Physicians of London, Pall Mall East, S.W.1, marked "Streatfeild Scholarship."

MR. ARTHUR HENDERSON, secretary of the Labour Party, appeals in the *Times* of April 8 for a large and

immediate increase in the Exchequer grants to universities and university colleges. The financial position of our universities in comparison with those of the United States and Germany was surveyed in an article in NATURE of August 15, 1918, and is stated in detail in a report published by the British Science Guild on "Industrial Research and the Supply of Trained Scientific Workers." The main facts stated by Mr. Henderson are given in these publications, and are familiar to most of our readers, but they cannot be brought under the notice of the public and our legislators too often.

MISS MAUD MARGARET GIBSON has placed in the hands of the Royal Society of Medicine a sum of money sufficient to provide a scholarship of the yearly value of about 250*l.* for medical research by women, in memory of her father, the late Mr. William Gibson, of Melbourne, Australia. The scholarship will be awarded from time to time by the society to qualified medical women who are subjects of the British Empire, and is tenable for two years, but may, in special circumstances, be extended to a third year. The scholar will be free to travel at her own will for the purpose of the research undertaken by her. There will be no competitive examination, nor need a thesis or other work be submitted. Applications must be sent in not later than May 3. Particulars may be obtained from Mr. J. Y. W. Macalister, secretary of the Royal Society of Medicine, 1 Wimpole Street, W.1.

SCIENTIFIC workers who are endeavouring to secure professional recognition by Government through a new degree to be granted by our higher technical institutions will be much interested in Prof. Camichel's account of what is proposed in this direction in France (*Revue générale des Sciences*, January 30, 1919). M. Pottevin has introduced a Bill in the Chambre des Députés for the establishment of autonomous technical institutes in connection with existing universities, the rector of the university being president in each case of a council which is to include representatives of the teaching staff, the Ministry, the departments, the municipalities, associated or private benefactors, chambers of commerce, and local workmen's organisations. It is proposed that these institutes should have power to grant degrees in applied science in the name of the State, such degrees, unlike those of the universities, carrying Government sanction for professional practice, as is already the case in the safeguarded degrees in medicine, advocacy, and pharmacy.

A BILL has been introduced in the United States Senate to create a Department of Education with a Secretary of Education, and granting money for educational purposes in co-operation with the States. The Bill proposes to distribute money to the States on condition that they raise equal amounts for the same purposes. It authorises an annual appropriation of 20,000,000*l.*, to be apportioned among the States for the following purposes:—(1) To encourage the States in the removal of illiteracy, 1,500,000*l.* (2) To encourage the States in the Americanisation of foreigners, 300,000*l.* (3) To encourage the States in the equalisation of educational opportunities, and for the partial payment of teachers' salaries, providing better instruction, extending school terms, and otherwise providing equally good schools for all children, 10,000,000*l.* (4) To encourage the States in the promotion of physical and health education and recreation, 4,000,000*l.* (5) To encourage the States in providing facilities for preparing and supplying better teachers, 3,000,000*l.* According to the New York *Tribune*, there are 700,000 illiterate males in the United States between the ages of twenty-one and thirty-one unable either to understand the principles for which they were called upon to fight or to read the Constitution they were expected to defend. There are at the present time in the United States 8,592,000 illiterates and persons unable to speak English, of whom 1,006,000 live in New York State and 621,000 in Pennsylvania. The Bureau of Education has reported that the average annual salary paid to American teachers in 1918 was about 126*l.*, which is about 49*l.* less per annum than the average wage paid to charwomen in the United States Navy Yard.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 3.—Sir J. J. Thomson, president, in the chair.—Dr. T. R. **Merton** and Prof. J. W. **Nicholson**: Note on the intensity decrement in the Balmer series. Twelve members of the Balmer series of hydrogen have been observed in vacuum tubes containing a trace of hydrogen in helium at a pressure of 41 millimetres of mercury. In contrast with the diffuse appearance of the last of these members in pure hydrogen, they were observed in the present instance as sharp, though faint, lines. A quantitative comparison of the intensity distribution in these tubes with that in tubes containing pure hydrogen, water-vapour, and a mixture of hydrogen and helium at low pressure has shown that the visibility of the higher members of the series in the high-pressure tubes is most probably due to the fact that the energy under these conditions is concentrated within narrow limits of wave-length, instead of being distributed through a broadened line the energy-content of which is, in fact, greater. The observed results seem to be incompatible with the quantum theory of the hydrogen spectrum developed by Bohr.—Prof. E. W. **Brown**: The determination of the secular accelerations of the moon's longitude from modern observations.—Dr. W. **Rosenhain** and S. L. **Archbutt**: The inter-crystalline fracture of metals under prolonged application of stress. The authors' observations have shown that in a number of metals, including lead, mild steel, and an alloy of aluminium with zinc and copper, the prolonged application of stress will, in certain cases, produce an abnormal type of fracture in which the crystals become separated from one another, instead of being broken or torn across in the normal manner. An exact similarity to this type of fracture is found in the "season cracking" of brass. In the latter case the applied stress is an internal one arising from elastic deformation. The authors base an explanation of this type of fracture on the hypothesis, formerly advanced by one of them and widely accepted among metallurgists, that the constituent crystals of metals are held together by thin layers of an amorphous inter-crystalline "cement," the properties of which resemble those of a greatly under-cooled liquid.—Dr. J. R. **Airey**: Zonal harmonics of high order in terms of Bessel functions.

Physical Society, March 14.—Prof. C. H. Lees, president, in the chair.—C. C. **Paterson** and N. **Campbell**: Some characteristics of the spark discharge and its effect in igniting explosive mixtures. The object of the investigation was to determine the relation between the electrical characteristic of a spark discharge and its power of igniting explosive mixtures. The results show that the igniting power of a spark increases with both the capacity discharging and the spark potential, and that the energy required for ignition decreases rapidly as the spark potential increases. Various other properties of sparks are described.

MANCHESTER.

Literary and Philosophical Society, March 18.—Mr. W. Thomson, president, in the chair.—Prof. G. Elliot **Smith**: The bird's brain. It has always been an

enigma that, in spite of their very scanty equipment of obvious cerebral cortex, birds should display, in their powers of tactile, visual, and acoustic discrimination, their associative memory, and their ability to learn by individual experience, such outstanding evidence of functions which are intimately associated in mammals with the activities of the cortex. The explanation of this apparent discrepancy between the morphology of the brain and the bird's aptitude to profit by experience is provided by the fact that a great part of the structure usually called "corpus striatum" is cortical in origin and in its fibre-connections.—M. **Christy**: The ancient legend as to the hedgehog carrying fruit upon its spines. This legend, at least two thousand years old, had been repeated by most of the classical and medieval writers on natural history, many of them adding to or improving upon the original story. The author reviewed the forms in which it had been presented, showing that the fruit said to have been carried varied geographically. He cited two instances which had come under his notice; both, though second-hand evidence, he believes to have some foundation in fact. He concludes that the hedgehog does eat fruit, and may occasionally intentionally carry it on its spines.

Paris.

Academy of Sciences, March 17.—M. Léon Guignard in the chair.—J. **Hadamard**: Remark on the residual integral.—C. **Richet** and G. **Noizet**: An unsinkable garment, protecting against cold. The garment is made of vulcanised cloth, similar to that used for balloons, lined internally with a thickness of about 15 mm. of kapok. In an apparatus for saving life at sea protection against cold is as important as protection against sinking. The garment made of the above material has been successfully subjected to actual tests; as a safety apparatus it has one drawback: it takes ten minutes to put on unassisted, or three minutes with assistance.—The Permanent Secretary announced the death of Edmund Weiss, correspondant of the Academy for the section of astronomy.—B. **Gambier**: Surfaces applicable one on the other.—H. **Cramer**: The zeros of the function $\zeta(s)$.—M. **Petrovitch**: Integral functions connected with the first numbers.—V. **Brun**: The theorem of Goldbach.—E. **Cotton**: The formula of Bernoulli.—C. **Raveau**: Carnot's calculation of the mechanical equivalent of heat. An unpublished document.—C. **Chéneveau** and R. **Audubert**: Absorption by turbid media. Influence of the diameter and the number of the particles. Lord Rayleigh's theorem is limited to the case in which the suspended particles are small with respect to the wave-length of the incident light. From experimental data a modified formula is proposed dealing with the case of larger particles.—L. **Abonnenc**: The laws of flow of liquids by drops in cylindrical tubes. If D and d are the external and internal diameters of the tube from which the drops are falling, T is the surface tension of the liquid, η its viscosity, ρ its density, N the frequency of fall, m and n successive powers of 2, then the weight of a drop p is given by the formula

$$p = \mathrm{ATD} + m\mathrm{B}\eta\mathrm{N} - n\frac{\mathrm{C}}{d}\rho\mathrm{N}^2,$$

where A, B, and C are constants independent of the liquid.—P. **Nicolardot**: The tempering of lead, tin, and thallium. These three metals can be tempered. They anneal themselves spontaneously at the ordinary temperature, with a rapidity increasing with the temperature.—O. **Bailly**: The action of alkyl iodides on neutral sodium phosphate in aqueous solution. The reaction takes place according to the equation

$$\mathrm{PO(ONa)_3 + RI = PO(ONa)_2 - OR + NaI},$$

the proportion of the phosphoric ether formed falling from 73·5 per cent. for methyl iodide to 10·6 per cent. for isobutyl iodide.—R. **Dubuisson**: The magnetic anomalies of the Paris basin.—J. **Lévine**: The periodicity of atmospheric waves. A curve of the annual barometric minima for the period 1700 to 1919 shows a recurring period of about ninety-six years.—H. **Hubert**: The prediction of squalls in western Africa.—A. **Trillat** and M. **Fouassier**: An apparatus designed for the study of the formation and persistence of fogs.—M. **Dechevrens**: The diurnal variation of the vertical electric current of the earth in the air (observations made at Jersey).—F. **Vlès**: Some optical properties of bacterial emulsions.—G. **Sanarelli**: The pathogeny of cholera.

March 24.—M. Léon Guignard in the chair.—A. **Rateau**: Quantity of total motion and mean velocity of a jet of gas emerging from a reservoir by a *tuyère*.—A. **Blondel**: The conditions of stability of synchronised alternators connected to a constant-pressure network.—H. H. **Hildebrandsson**: Preliminary reflections on the general movements of the atmosphere. From a study of experimental data only, without regard to any existing theories, nine conclusions are drawn of atmospheric movements, the most important being that there is no evidence of a direct higher current from the equator towards the poles, neither is there a lower current in the opposite sense.—G. **Julia**: Some general properties of integral functions related to Picard's theorem.—A. **Petot**: The analytical theory of hydraulic turbines.—C. **Rabut**: Static synthesis of constructions.—G. **Guillaumin**: Ram strokes in pipes of variable diameter.—R. **Ledoux-Lebard** and A. **Dauvillier**: The spectral structure of the J rays. The spectrum of the J rays, discovered by Barkla and White, should be very simple, possibly one radiation only. Boron appeared to be indicated as a suitable source of these rays, and experiments with this material are described. No line of wave-length near $\lambda = 0{\cdot}43$ Å.U. could be detected.—H. **Copaux**: A method of extracting glucina from beryl. The mineral is heated to 850° C. with sodium fluosilicate, and the fritted mass extracted with boiling water. The greater part of the silica and alumina remains undissolved.—L. **Benoist**: A reaction and method for the estimation of ozone. The method is based on the destruction of the dye fluorescein by ozone, and can detect and estimate quantities down to a millionth of a milligram of ozone.—A. **Guébhard**: A new point of view in metallogenesis.—Ph. **Glangeaud**: The volcanic group, Banne d'Ordanche, Puy-Loup, and Puy-Gros, of the Monts Dore massif. A remarkable volcanic and hydrothermal fault.—G. **Reboul** and L. **Dunoyer**: The mutual actions of low and high barometric pressures.—A. **Baldit**: Cold storms and their trajectories.—F. **Maignon**: Study of the mechanism of the action of fats in the utilisation and assimilation of albuminoids. A theory is developed to explain the experimental results published in earlier communications. It is supposed that the amino-acids arising from the partial digestion of the albuminoids can recombine with fatty acids from the fats. This would explain not only the increased assimilation, but also the observed reduction in the toxic power of the albuminoids.—J. L. **Dantan**: The origin of the sexual cells in *Parantipathes larix*.—F. **d'Hérelle**: The *rôle* of the filtering anti-bacterial micro-organism in typhoid fever. The study of twenty-eight cases of typhoid fever has led to conclusions similar to those arrived at for dysentery. Coincident with improvement in the patient, there appeared in the fæces a substance possessing a powerful bactericidal action upon the typhoid bacillus, which can only be attributed to an antagonistic micro-organism.

BOOKS RECEIVED.

Van Nostrand's Chemical Annual. Fourth issue. 1918. Edited by Prof. J. C. Olsen, assisted by Lieut. M. P. Matthias. Pp. xviii+778. (London: Constable and Co., Ltd.) 15*s.* net.

The Century of Hope. By F. S. Marvin. Pp. vi+352. (Oxford: At the Clarendon Press.) 6*s.* net.

Report on an Inquiry into the Silk Industry in India. Vol. i.: The Silk Industry. By H. Maxwell-Lefroy. Pp. ii+211. Vol. ii.: Present Condition of the Silk Trade of India. By E. C. Ansorge. Pp. vi+115. Vol. iii.: Appendices to Vol. i. By H. Maxwell-Lefroy. Pp. 237. (Calcutta: Superintendent Government Printing, India.) Vol. i., 3*s.*; vol. ii., 2*s.*; vol. iii., 4*s.* 2*d.*

The Journal of a Disappointed Man. By W. N. P. Barbellion. With an introduction by H. G. Wells. Pp. x+312. (London: Chatto and Windus.) 6*s.* net.

Catalogue of Lewis's Medical and Scientific Circulating Library. New edition, revised to the end of 1917. Pp. vi+492. (London: H. K. Lewis and Co., Ltd.) 12*s.* 6*d.* net.

The War Work of the Y.M.C.A. in Egypt. By Sir J. W. Barrett. Pp. xx+212. (London: H. K. Lewis and Co., Ltd.) 10*s.* 6*d.* net.

Strife of Systems and Productive Duality: An Essay in Philosophy. By Prof. W. H. Sheldon. Pp. x+534. (Cambridge, Mass.: Harvard University Press; London: Humphrey Milford.) 15*s.* net.

Concealing-coloration in the Animal Kingdom. By G. H. Thayer. With an introductory essay by A. H. Thayer. New edition. Pp. xix+260+xvi plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 25*s.* net.

Criminology. By Dr. M. Parmelee. Pp. xiii+522. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

Soils and Fertilizers. By Prof. T. L. Lyon. Pp. xx+255. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

The Mastery of Nervousness, Based upon Self-Re-education. By Dr. R. S. Carroll. Third revised edition. Pp. 348. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

The Living Cycads. By Prof. C. J. Chamberlain. Pp. xiv+172. (Chicago, Ill.: The University of Chicago Press.) 1.50 dollars net.

Le Rocce: Concetti e Nozioni di Petrografia. By Prof. E. Artini. Pp. xx+636+plates xxxii. (Milano: U. Hoepli.) 18.50 lire.

Self and Neighbour: An Ethical Study. By E. W. Hirst. Pp. xix+291. (London: Macmillan and Co., Ltd.) 10*s.* net.

Aids in Practical Geology. By Prof. G. A. J. Cole. Seventh edition, revised. Pp. xvi+431. (London: C. Griffin and Co., Ltd.) 10*s.* 6*d.* net.

The Elements of Astronomy for Surveyors. By Prof. R. W. Chapman. Pp. x+247. (London: C. Griffin and Co., Ltd.) 5*s.* net.

Les Principes de l'Analyse Mathématique: Exposé Historique et Critique. By Prof. P. Boutroux. Tome ii. Pp. 512. (Paris: A. Hermann et Fils.) 20 francs.

DIARY OF SOCIETIES.

THURSDAY, APRIL 10.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—A. E. Seaton: The Work of the British Marine Engineering Design and Construction Committee.—Signor S. Orlando: Italian Two Floodable Compartment Cargo Steamers Built during the War.—Sir E. H. Tennyson d'Eyncourt and T. Graham: Some Recent Developments towards a Simplification of Merchant Ship Construction.—At 3.—C. I. R. Campbell: Development of Airship Construction.—W. L. Scott: Concrete Shipbuilding in the United States of America.—At 7.30.—The Hon. Sir C. A. Parsons and Stanley S. Cook: Investigation into the Causes of Corrosion and Erosion of Propellers.—J. H. Gibson: The Michell Thrust Block.

ROYAL INSTITUTION, at 3.—Prof. A. Findlay: Colloidal Matter and its Properties.

INSTITUTION OF MINING AND METALLURGY, at 5.—Major H. Standish Ball: The Work of the Miner on the Western Front.

ROYAL HISTORICAL SOCIETY, at 5.—R. A. Gregory: Science in the History of Civilisation.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—R. J. Kaula: Notes on Surface Condensing Plants, with Special Reference to the Requirements of Large Power Stations.

OPTICAL SOCIETY, at 7.30.—J. W. French: The Unaided Eye.—T. Smith: The Spacing of Glass-working Tools.

FRIDAY, APRIL 11.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—W. H. Gard: Some Experiences with Electric Welding in Warships.—Dr. J. Montgomerie: Further Experiments on the Stress Determination in Flat Steel Plates.—A. T. Wall: The Tonnage of Modern Steamships.—At 3.—J. L. Kent: Model Experiments on the Effect of Beam on the Resistance of Mercantile Ship Forms.—J. Semple: Some Experiments on Full Cargo Ship Models.

ROYAL ASTRONOMICAL SOCIETY, at 5.—J. H. Jeans: The Origin of Binary Systems.—*Probable Papers:* Dr. A. A. Rambaut: A Short Table for Directly Converting Estimates of Brightness into Stellar Magnitudes on Pogson's Scale.—Rev. T. E. R. Phillips: Note on a Remarkable Change in the South Tropical Region of Jupiter.

ROYAL INSTITUTION, at 5.30.—Sir J. J. Thomson: Piezo-Electricity and its Applications.

SATURDAY, APRIL 12.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, APRIL 14.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Dr. J. Ball and H. K. Shaw: The Astrolabe à Prisme.

INSTITUTION OF ELECTRICAL ENGINEERS, at 7.30.—Dr. R. D. Gifford: Opener of a Discussion on Electrical Instruments.

TUESDAY, APRIL 15.

ROYAL STATISTICAL SOCIETY, at 5.15.—Dr. A. L. Bowley: The Measurement of Changes in the Cost of Living.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—C. Greenway: Valedictory Address.—Sir F. W. Black: Presidential Address, Some War Problems of Petroleum Supply.

WEDNESDAY, APRIL 16.

ROYAL METEOROLOGICAL SOCIETY, at 5.—A. A. Barnes: Rainfall in England; the True Long-average as Deduced from Symmetry.—C. E. P. Brooks: The Secular Variation of Rainfall.

ROYAL AERONAUTICAL SOCIETY, at 8.—Dr. F. C. Lea: Aluminium Alloys for Aeroplane Engines.

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THURSDAY, APRIL 17, 1919.

GYROSCOPICS.

A Treatise on Gyrostatics and Rotational Motion. Theory and Applications. By Prof. Andrew Gray. Pp. xx+530. (London: Macmillan and Co., Ltd., 1918.) Price 42*s*. net.

THE exhibition at the International Mathematical Congress at Cambridge in 1912, although unnoticed in the official record of the Proceedings, was attractive as a collection of scientific books on view of all the chief publishers in the world, and of apparatus designed for use in mathematical instruction, including a very complete assortment of calculating machines of all kinds.

But the foreign visitor was delighted chiefly to see and handle the gyrostats and apparatus, and so to clear up much of the obscurity in the mere description and diagrams of the "Treatise on Natural Philosophy" of Thomson and Tait.

The apparatus was designed, and explained, and shown at work in the skilful hands of Dr. James Gray, son of our author, engaged since in the development of the warlike applications; and we are promised a sequel devoted to this side of the subject of gyrostatics as soon as the seal of secrecy has been removed with the advent of peace.

Mention and description can then be made, too, of the peaceful applications of gyroscopic principles, such as to the design of the centrifuges employed for centrifugal and whirling operations in chemical and laundry work, to drain off the moisture in a saturated substance swiftly and with no internal disturbance. These were described in *Engineering* for February 7 last, where each centrifuge must be treated as a great spinning-top, upright as if asleep, requiring the upper end to be quite free in precession, and so actuated from the lower end of the axle, in this case by a Pelton wheel.

The gyro-compass is held over to the sequel, as involving the operation of secret processes; without it the navigation of a submarine could not have been possible. But a full description is given in chap. viii. of Schlick's sea gyroscope, with the theory designed to ensure a dry ship and easy roller in all weather.

Prof. Gray has succeeded, in the chair of natural philosophy at Glasgow University, to the gyrostatic apparatus of Lord Kelvin, his predecessor, and has added important developments of his own invention. As shown in the diagrams, these are of elaborate construction, and demand the aid of electric motive power to impart and maintain the high rate of revolutions required, and so will not be allowed far from the lecture-desk.

But Maxwell's opinion must be maintained that the real instruction of the student is derived from the crude apparatus made by his own hands, and that he learns most from his own failures.

So we venture to suggest to Prof. Gray the encouragement of his students in the use of such simple apparatus as that in his Fig. 30(*b*) on p. 128, where a bicycle wheel is shown as a cheap, efficient top, spun by hand, and no string or electric motor is required. If the ordinary 28-in. wheel is not considered large enough, it will cost little more to order one of double or three-fold diameter, as the delicate part of the hub and ball-bearings can serve for all, and is bought cheap when manufactured in large quantities These can be handled and thrown about, and brandished, and so provide the muscular sensations on a large scale of gyroscopic domination. Any inventor's idea can be tested at once and an advantage followed up.

If the point of a top is free to wander about on the floor, either as a sharp tip or a rounded ball, the dynamical treatment is intractable in the present state of mathematical analysis.

The point must be kept still, and we avoid the hideous unreality of the "perfectly rough" of the text-book jargon by placing it, as in Fig. 30(*a*), in a small cup recess, the wheel spinning freely about the ball-bearings of the hub fixed on the stalk.

The top must then have uniaxial symmetry if the motion is to be expressible by the elliptic function, as explained in chap. xii.; and these functions appear created expressly to speak the language of such gyroscopic motion.

In the old Cambridge mathematical tradition, praised by Todhunter, it was considered of no intellectual merit to have seen and worked an experiment in Natural Philosophy and not to have grasped the idea by mere thinking.

Maxwell strove hard to destroy this tradition, and pointed out the superiority at Glasgow of Sir William Thomson's stimulating treatment of dynamics with experiments. Maxwell was given a chance of working out his ideas by the erection of the Cavendish Laboratory for his benefit, gift of the Chancellor, the Duke of Devonshire. But as Maxwell's inaugural lecture was delivered to bare walls, the Chancellor desired to make his gift complete by presenting an appropriate collection of apparatus. Such an order could not be given out at once in those days, and the demands extended over a few years, during which some busybodies, self-styled business men, were always worrying Maxwell to make his final demand and declare the Cavendish Laboratory complete; and as Maxwell was then approaching his fatal illness he was too weak to protest, leaving his successor, Lord Rayleigh, the inheritance of a large establishment with no endowment for upkeep and progress.

The tradition there of research has been chiefly electrical, so that the interests of dynamics have not been studied equally, and, to judge from the ordinary text-books in use, the old Victorian tradition still survives, copied from one to the other, and not looking up from the page at the great developments taking place around, a great contrast to Prof. Gray's treatise before us.

The elliptic function solution is restricted to the top of uniaxial symmetry. If the top is taken to be a body of any shape, as may be imitated with

the screws of the Maxwell top, the analytical complexity in chap. xvii. defied a Weierstrass, who handed his difficulties over to the young Kowalevski, to break her teeth over the problem.

The ardent spirit is not deterred, but, on the contrary, rather stimulated, to tackle a question declared intractable; so Prof. Gray gives a *résumé* in chap. xvii. of the progress made so far by other daring mathematicians—Russians for the most part—although we miss a figure and description of the Maxwell top, to be placed on the table in front and twirled by a finger and thumb.

The spherical pendulum of chap. xv. was early to receive attention as a problem in mere particle dynamics, realised in swinging a plummet about at the end of a thread. This is a case of gyroscopic-top motion where the component angular momentum (A.M.) about the axle is zero, and is realised in the apparatus of Fig. 30(*b*) by projecting the wheel without rotation. But this limitation makes the motion very uninteresting analytically, except as illustrating a solution of a Lamé equation of the second order. The simple case of holding out the axle horizontal, and projecting it horizontally without any rotation of the wheel, is of interest as giving a state of motion that has a simple analytical solution, which may be written down here:

$$\sin\theta\cos(\psi - ht) = \sqrt{(\sec\theta_3 - \cos\theta_3)}\sqrt{(\cos\theta)},$$
$$\sin\theta\sin(\psi - ht) = \sqrt{(\cos\theta_3 - \cos\theta . \cos\theta + \sec\theta_3)},$$

where $2h$ denotes the precession when the axle is horizontal, and θ_3 is the extreme angle of the axle with the downward vertical, to which the axle sinks and then rises up again to the horizontal.

This can serve as a penultimate case where the spherical pendulum is whirled round swiftly, apparently in a horizontal circle, as with the lariat or bola, as on p. 302, contrasted with swift whirling in a vertical circle, penultimate case of pendulum motion, and an extreme contrast to small plane oscillation near the vertical.

Lagrange came to grief over the small conical oscillations of the spherical pendulum (*cf.* § 5, p. 302), yet he could have saved himself and detected his error but for the self-imposed restraint of excluding the diagram from his "Mécanique analytique." So it is curious to find the same fashion coming again in the modern school of pure analytical treatment, of doing away with an appeal to the visual sense of a geometrical figure.

In swift rotation about an axis in the neighbourhood of a principal axis, as the axis of figure of a symmetrical top, the instantaneous axis does not wander far from the principal axis, and the axis of A.M. keeps close by also, even when the body, like the top, is acted on continuously by a force or couple which causes the A.M. vector to move.

The kindergarten explanation of top motion, in considering only the rotation about the axis, can then be made more exact, when it is assumed that the divergence of the axis of A.M. and angular velocity from the axis of figure is always small, so that one may be used indiscriminately for the other.

In this way, by calling CR the A.M. above the axis of figure, and $gMh\sin\theta$ the couple of gravity on the top when the axis points up at an angle θ with the upward vertical, the simple formula is obtained for μ, the precession:

$$\mu CR\sin\theta = gMh\sin\theta, \quad \mu = \frac{gMh}{CR},$$

provided θ is not too small.

Poinsot applied the same principle in his treatment of precession and nutation ("Connaissance des temps," 1858), assuming the divergence of the axis of rotation and of A.M. from the axis of figure of the earth as insensible; otherwise we should see the stars dancing about. The treatment here in chap. x. could be simplified in Poinsot's method. The Glasgow problem on p. 13 of the calculation of the diameter of the earth's axis at the pole may be cited as a justification of Poinsot's assumption.

It was a mathematical genius who changed in precession to the reckoning in $\frac{A, C}{C-A} = 304, 305$, or some say 305, 306, instead of the usual reciprocals in small decimals, indistinguishable numerically. And we venture to put in a plea for the sidereal day as the unit of time in these measurements, and not the solar year, thus making $R = 2\pi$ for the earth.

The effect of precession is to shorten the year about twenty minutes, and thus the period is 26,000 years of a complete revolution of the equinox through the stars. The classical scholar may be encouraged to take up the study of Astronomy when he hears that stray references to the stars by Homer are a guide to us in assigning limits to the age in which he lived and wrote. Astronomy was a much more living, actual interest in the days before clock and watch was so plentiful.

G. Greenhill.

A PHYSIOLOGIST'S CONTRIBUTION TO WAR SURGERY.

Intravenous Injection in Wound Shock. Being the Oliver-Sharpey Lectures delivered before the Royal College of Physicians of London in May, 1918. By Prof. W. M. Bayliss. Pp. xi + 172. (London: Longmans, Green, and Co., 1918.) Price 9*s.* net.

THE war has brought into touch with directly practical problems many whose interests, before its outbreak, lay in fields of investigation which were popularly regarded as purely academic and remote from contact with everyday needs. In no department of research has the value of "pure" science been more finely vindicated than in that of physiology; and the gain to both physiology and practical medicine from this closer alliance of theory and application has been the subject of general remark. There could scarcely be a better example of this recent tendency than Prof. Bayliss's book on the treatment of "wound shock," which embodies, with much added detail and illustration, the substance of his

Oliver-Sharpey lectures, delivered before the Royal College of Physicians in 1918.

The subject of "shock" was one which offered little attraction, under normal conditions, to the laboratory worker, with his habit of precision in nomenclature and his love of the clearly defined problem. To the surgeon the problem was a sufficiently definite and urgent one, but there was always the suspicion, not even yet dispelled, that the term covered any condition in which the vital functions suffered rapid depression, and that the common factor was obscurity of causation. The same applied to "wound shock" in the earlier stages of the war, but Prof. Bayliss shows how the co-ordinated efforts of physiologists working at home and surgeons working in the clearing stations succeeded in reducing the complexity of the problem. He shows that the question of causation has by no means yet received a final answer; it is still obvious that the contributory factors are numerous, and that their relative importance varies widely from case to case. The central feature of the condition, however, is constant—a deficient volume of the blood in effective circulation. In the large majority of cases the loss has a twofold origin; blood has been lost from the system by actual hæmorrhage, and of what remains part is rendered ineffective for the needs of the body by the tendency to stagnation in the peripheral vessels. In the production of this latter phenomenon a central importance is attributed to the absorption from injured tissues of the toxic products of autolytic changes. Fat-embolism receives brief mention, but might with advantage be given fuller consideration in a future edition. Probably too general a significance has been attributed to it by some American writers, but its occurrence may possibly throw light on the appearance of "shock" in certain cases with no obvious destruction of the tissues, and on the complete failure in such cases of efforts to restore the blood volume.

A large part of the book is devoted, as its title indicates, to the treatment of shock by intravenous injections. The theoretical considerations and experimental findings leading to the introduction of gum-acacia solution, as a substitute for the deficient blood, receive full treatment. The importance which, in certain passages, is attributed to deficient oxygenation of the blood seems scarcely consistent with what is said elsewhere as to the relatively small importance of oxygen-carrying power, in comparison with the volume and the rate of circulation of the fluid in the vessels. There seems as yet to be no evidence which would enable us to estimate the relative importance, as factors in the bad effects of a retarded circulation, of the reduced supply of oxygen on one hand, or of the defect of the mechanical flushing of the tissues on the other, by which toxic metabolites are normally swept away, possibly to be destroyed in the liver or eliminated by the kidneys. The effect on the function of the kidney of replacing blood by gum solution is not here recorded, and seems worth investigation.

Prof. Bayliss does not deal specifically with the application of conclusions, drawn from the study of "wound shock," to the "surgical shock" of civilian practice. It is to be hoped that the efficiency of his gum solution, which has done such splendid service during the war as a substitute for lost blood, will be further tested under the more rigid observation which peaceful conditions will make possible.

H. H. D.

INTRODUCTORY METEOROLOGY.

Introductory Meteorology. Prepared and Issued under the Auspices of the Division of Geology and Geography, National Research Council. Pp. xii+150. (New Haven: Yale University Press, 1918.) Price 4*s.* 6*d.* net.

"IN the United States meteorology is included in the course of study outlined by the Committee on Education and Special Training of the War Department for Students' Army Training Units. The plan involves an intensive study of the elements of the subject in order to familiarise prospective Army officers with its chief conclusions and methods." It is to meet this requirement that "Introductory Meteorology," a work of a hundred and fifty octavo pages, including seventy excellent illustrations, has been prepared by members of the staff of the United States Weather Bureau, including W. J. Humphreys, S. P. Fergusson, W. R. Gregg, J. Warren Smith, A. J. Henry, and C. F. Talman, who are all recognised as experts in the special subjects assigned to them.

In this country no committee on education and special training of the War Department has as yet included meteorology in the course of study for Army officers, but the experience of the war has impressed upon us the necessity for setting out the elements of the subject, and the Meteorological Office has endeavoured to satisfy the requirement provisionally by the issue of the "Weather Map and Glossary" and a number of other publications. It is interesting to compare notes about these endeavours to meet a common necessity.

Though it sets out a considerable number of well-selected facts and illustrations, many of them quite novel, "Introductory Meteorology" is, from the nature of the case, little more than an enlarged prospectus of the whole scope of meteorology, including climatology and forecasting. The primary difficulty of such an enterprise meets us on almost every page, and that is to decide how much preliminary knowledge of physics and mathematics on the part of the reader is to be assumed by the author. The most effective chapter is one on "Atmospheric Optics," in which the author, with an obvious command of the subject, boldly tells the reader what he may see and what may be explained without entering into the details of explanation. There is no attempt to define refraction or diffraction. In other chapters less assurance is shown, and the author hesitates between assuming and expounding the experience

of the physical laboratory, and therein he has our sympathy, combined with some amusement when we think of the lay mind pondering over such a sentence as: "By [dynamic heating and cooling] is meant that, if air is compressed, work is done and its temperature is raised, and if expanded it does work and is cooled"; or the still more cryptic utterance about fog: "When the water appears to be steaming—actually evaporating into air already saturated and thus inducing condensation."

The pose as regards knowledge of the physical processes of such phenomena as the distribution of temperature over the surface and in the upper air, or the trade winds and monsoons, is reminiscent of the heedless assurance of the old physical geographer rather than of the caution of the modern physicist, but the ambition to place the whole of meteorology upon a sound physical basis is a very worthy one and worthily attempted. The book should have a hearty welcome. We look forward to its expansion and development with confidence. It is well executed, and the illustrations are remarkably apt. Among some beautiful photographs of cloud-forms Fig. 54 (alto-cumulus) seems to be printed upside down, but that is the only misprint we have noticed.

NAPIER SHAW.

OUR BOOKSHELF.

Agricultural Laboratory Exercises and Home Projects adapted to Secondary Schools. By Henry J. Waters and Prof. Joseph D. Elliff. Pp. vi+218. (Boston and London: Ginn and Co., 1919.) Price 4*s.* 6*d.* net.

IN this book the authors set out exercises suitable for students in secondary schools where agriculture is a prominent subject and occupies a considerable part of the curriculum. The exercises fall into two groups—those to be carried out in the laboratory, and those to be done at home on the farm, or, in the case of town dwellers, on the school ground.

The laboratory classes follow the conventional lines; indeed, in no branch of agricultural science perhaps has there been less advance during past years than in schemes of exercises suitable for students. Nevertheless, although there is little or no novelty, the book is likely to be quite serviceable to teachers. The old favourite exercises that have served for several generations of students are here, and all of them, as the authors say, have been "tried out," and can be relied upon to give decisive results if the directions are properly followed. In a few cases the experiment does not really prove the point intended. Thus, one exercise is intended "to demonstrate how the soil food enters a plant." The student is instructed to close the end of a thistle funnel with parchment, fill with sugar solution, and invert in a vessel of distilled water. The experiment illustrates several points, but it does not show how soluble solutions pass into the plant. Another experiment, "the air as a source of plant food," shows an even greater divergence between the intention and the accomplishment.

To English readers the novel part is that dealing with "project work." Pupils in all schools in the States receiving Federal aid under the Smith-Hughes Act are required to do some of their agricultural work at home or on the school farm; this is called a project. The project must represent a sustained effort of considerable magnitude; in the authors' description it must be "worth while"; detailed records of costs, time, methods, and income must be kept; the work must be done under proper supervision, and it must form the subject of a written report by the student. The projects described here include the growth of maize and of vegetables for profit, selection of seed corn, preparation of a seed bed, finding the "failure cow" in a herd, the discovery of the soil requirement, etc. The collection will be found of distinct value to the teacher.

The Voice Beautiful in Speech and Song. A Consideration of the Capabilities of the Vocal Cords and their Work in the Art of Tone Production. By Ernest G. White. (New and enlarged edition of "Science and Singing.") Pp. viii+130. (London: J. M. Dent and Sons, Ltd., 1918.) Price 5*s.* net.

THE opening sentences of chap. ii. of this book are as follows: "The whole burden of this book is to show and, if possible, convince the world in general that the vocal cords, situated on the top of the windpipe, in what we call our throat (diagram I.), are not the seat of sound—that is to say, in neither speech nor song do the vocal cords actually create the tone." We venture to say that no physiologist will support this statement. It is true that sound can be produced by other parts of the apparatus, and without necessarily the presence of the vocal cords, but that the vocal cords vibrate and are the chief agents in producing tones has been proved to the satisfaction of all who study the parts and can employ the laryngoscope. The author is right so far in attributing importance to the sinuses in some of the bones of the face and skull, but he exaggerates their function of acting as resonators to strengthen or modify tone. Over and over again he furnishes what he regards as evidence in support of his thesis, but the conclusion, almost invariably, is in the opposite direction.

Still, there is much to admire in this book. It is clever and even witty; it shows wide reading in physiology and in the related sciences, and the illustrations from original preparations are worthy of all praise; indeed, it may be said that the anatomical details are brought out so clearly as to be well worthy of study. As a teacher of vocalisation the author maintains that he has met with success, without laying stress on the alleged functions of the vocal cords; this we admit, but, if he has done so, this success must really depend on the mechanism as generally understood, and not on the production of tone by the sinuses in the head.

J. G. M.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Finger-print System in the Far East.

IN Henri Cordier's new edition of Sir Henry Yule's "Cathay and the Way Thither" (1914) I came across the following note by the editor (p. 123, vol. iii.):—

"With regard to the finger-print system in the Far East we shall make the following remarks: In NATURE of October 28, 1880 (p. 605), Mr. Henry Faulds, writing from Tokyo, drew the attention to the use made by Japanese of finger-prints, and came to the conclusion 'that the Chinese criminals from early times have been made to give the impressions of their fingers, just as we make ours yield their photographs.' In the same periodical (November 22, 1894, p. 77) Sir W. J. Herschel claimed to have been the first to exhibit the system of finger-prints on board the P. & O. s.s. *Mongolian* in February, 1877. This system he had found in 1858 and communicated to Mr. Galton, who made use of it in his 'Finger-Prints' (1892); hence the discovery of the system was ascribed to Sir W. Herschel in a Parliamentary Blue Book. Sir W. Herschel added in his letter that, to the best of his knowledge, the assertion that the use of finger-marks in this way was originally invented by the Chinese was wholly unproved. Sir W. Herschel was entirely wrong; Mr. Faulds (*ibid.*, October 4, 1894, p. 548) protested against the claim of Sir W. Herschel, and finally a Japanese gentleman, Kumagusu Minakata (*ibid.*, December 27, 1894, p. 199), proved the case for the Japanese and the Chinese. None of these writers quoted the passage of Rashîd-ud-dîn, which is a peremptory proof of the antiquity of the use of finger-prints by the Chinese."

The passage referred to in Rashîd-ud-dîn is quoted by Yule on the same page in the following words:—

"It is usual in Cathay, when any contract is entered into, for the outline of the fingers of the parties to be traced upon the document. For experience shows that no two individuals have fingers precisely alike. The hand of the contracting party is set upon the back of the paper containing the deed, and lines are then traced round his fingers up to the knuckles, in order that if ever one of them should deny his obligation this tracing may be compared with his fingers, and he may thus be convicted." (Sir H. Yule's translation from the French translation of the Arabic text by Klaproth, in *Journ. As.* for 1833 (?), pp. 335–58 and 447–70.)

It seems to me that the description of the process by Rashîd-ud-dîn, so accurate and explicit, can in no way apply to the method of identification by finger-prints. There is no indication of a preliminary blackening of the hand, or of an impress left on the paper. It is definitely said that the process consists in the drawing of an *outline* of the extremities of the fingers "up to the knuckles" while the hand is set on the sheet of paper

Either Rashîd-ud-dîn has entirely misunderstood the description given to him by Pûlad Chingsang, the envoy of the Grand Khan to Tabritz, from whom he appears to have gathered most of his information regarding the Mogul Empire (*ibid.*, p. 111), or we have here the description of a process of identification hitherto unknown.

Anybody who will take the trouble to trace the outline of the outstretched fingers of the hands of different individuals will easily gather how different are the figures obtained in regard to the absolute and relative lengths of the fingers, to their relative distance from one another, to the angle made by the axis of the thumb with the axis of the index, and so on.

Whether these differences correspond with a distinctly characteristic drawing for each individual person, so as to make the process a real method of personal identification, I am not prepared to say, but the matter might be worthy of further investigation.

FILIPPO DE FILIPPI.

Rome (23), Via Urbana 167, April 3.

Supposed Effect of Sunlight on Water-drops.

Is it not the fact that sunshine causes a kind of "greasiness" which makes drops of water roll up when in contact with glass instead of spreading uniformly over the surface? I have frequently been troubled with this action when endeavouring to mount diatoms, and it is only recently that I have observed that it comes on as soon as the sun begins to shine, and that when the operation is performed in dull weather the difficulty does not arise. In clearing the diatoms from flocculent matter my practice is to rock the material from side to side in a shallow dish, dragging the diatoms into lines and rolling the dust and dirt off into lumps that can be sucked up with a syringe, but this process fails in sunshine owing to the diatoms floating. The evolution of a thin film of gas or vapour on the surface of the glass is a suggested explanation.

G. H. BRYAN.

A SOUTH AFRICAN PIONEER.[1]

THE subject of this biographical volume—the great hunter and pioneer of South Central Africa—has left behind him a name which, as one of his friends—a South African administrator—has said of him, "stands for all that is straightest and best in South African story." The writer of this notice can only think of one close parallel to him, the very similarly compacted James Chapman, of mixed English, Dutch, and French parentage, who preceded Selous, rivalled him as hunter, and resembled him in sweetness of character, transparent honesty, and love of Nature-study. Chapman, however, has been far more unlucky than Selous, not only in lack of Government appreciation of his merits and qualities, but also in never having had a biographer. Selous is at least made known, to those who have the leisure and inclination to read, by this work of Mr. J. G. Millais—mentally a twin brother—who has enriched his "Life of Selous" by some very beautiful drawings, the more beautiful in that they are so wonderfully true to actuality.

The book opens with an account of Selous's ancestry and relations, contributed by a brother and a sister. The genealogy, trailing off to Scottish kings and Midland worthies, mentions the French-Huguenot and Jersey origin and associations of the main stock, but says nothing on a point that certainly interests myself. I remember first meeting F. C. Selous in 1881 at the house in Harley Street of Sir Alfred Garrod, the great gout

[1] "Life of Frederick Courtenay Selous, D.S.O., Capt. 25th Royal Fusiliers." By J. G. Millais. Pp. xiv+387. (London: Longmans, Green, and Co., 1918.) Price 21s. net.

specialist. I was told then that he was a cousin of the family (which also had a French origin, as has been the case with so much of our intellectual, commercial, industrial, and Civil Service aristocracy). I used, earlier than that, to hear of Selous from the Garrods, especially Alfred H. Garrod, the prosector of the Zoological Society (one of the most remarkable men I ever met, who died at the age of thirty-three). My memory cannot have wholly deceived me on this point, since I knew Selous pretty well, and several times in more recent years referred to the Garrods in conversation, believing that this fellow-explorer of Africa had derived—as I had done—some or much of his interest in zoology from Prof. A. H. Garrod.

Another point in the biography which is left too indefinite for our natural curiosity is what led to the actual starting of Selous for South Africa in 1871, with the helpful capital of 400*l.* in his pocket. He was then only in his twentieth year. After leaving Rugby at seventeen, he was sent by his father to Switzerland, Germany, and Austria to study languages and presumably medicine, since his parents seemed to have wished him to become a doctor. But from early boyhood he had set his desires on the very life he ultimately led, one of adventure in Africa—adventure first, but incidentally the making of sufficient money by the produce of the chase, especially elephant ivory. In Germany he met a family returning on a holiday from Natal, and the enthusiastic account husband and wife gave of that truly delightful colony further determined Selous to make for South Africa. But what led to his parents' conversion to the idea, to the extent of allowing him to start at the very early age of nineteen, and to finance him so liberally, we are not told.

Selous soon justified their belief in him and his choice of a career. He came back to England (having pushed far into Zambezia) in 1875, apparently with a good sum of money on the right side of the balance through his luck and skill in shooting elephants. He returned to the land of his love in 1876, and did not revisit England until 1881. He was again back in South Africa in that year; then occurred another few months' holiday in England in 1886; after which Selous became associated markedly with the pioneering work which between 1887 and 1893 laid the foundations of Southern Rhodesia. On his return to England in 1893 he was engaged to be married and was proposing to increase his provision for the married state by a lecturing tour in America, when the first war with the Matebele broke out. Consequently he felt it his duty to return to South Africa and place his services at Mr. Rhodes's disposal. He was wounded in this campaign. When it was over he returned home, got married, and made a very extensive wedding tour through Eastern Europe, collecting birds' eggs. The year 1895 found him again in Rhodesia attempting to create a farming settlement.

FIG. 1.—Buffaloes alarmed. From "Life of Frederick Courtenay Selous."

The second Matebele War, which followed the Jameson Raid, temporarily broke up the farming settlement at Essexvale, and Selous had once more

to take part in South African warfare (the fact that he did so twice with conspicuous success and usefulness, both as officer and negotiator-interpreter, renders more fatuous than ever the attempt of Mr. H. J. Tennant, then Under-Secretary for War, and Lord Kitchener to deter him from going out to German East Africa in 1914). After the second Matebele War was over Selous and his wife returned to England and made their home in Surrey. Although—according to his biographer—Selous was treated shabbily by Cecil Rhodes and the Chartered Company, other South Africans endeavoured in some way to recompense him for his noteworthy services to British South Africa; so that with the remains of the capital he had put together during his many years of elephant-hunting, book-writing, and lecturing, he had by 1897 acquired a modest competence; enough to permit of his living quietly in England and making hunting trips and egg-collecting journeys in America, Asia Minor, and East Africa.

He was not made use of by Mr. Chamberlain or the Colonial Office in any advisory capacity because, it is said, of his plain speaking over the Boer War, mainly as to the causes that led up to that war; and despite the fact that he spoke South African Dutch and was immensely respected by both Dutch and British in South Africa, he was not employed by the War Office during the long-drawn-out campaigns of 1899–1902. A lingering prejudice seems to have actuated the War Office in 1914 in declining his services as a volunteer in any capacity to defend British East Africa in 1914 or to attack German East Africa in 1915. Similarly the Colonial Office and War Office—Lord Kitchener being most to blame—refused to employ other great African pioneers in the East African campaign, with the result that during the first twelve months of the war it was characterised by blunders and disasters, nearly all of them due to complete lack of local knowledge—knowledge of the geography, climate, people—which men like Selous and Sir Alfred Sharpe would have been able to supply.

When Selous was allowed—grudgingly—to go in the middle of 1915, he did some very effective soldiering until he was killed in an attack at the head of his men on a little German fort at Behobeho on January 4, 1917. (Behobeho is the place where another African pioneer, Alexander Keith Johnston, lies buried—1879.)

Selous, between the later 'seventies and 1914, enormously enriched the national collections at the British Museum of Natural History, for which, of course, he received no recognition from a science-ignoring (rather than -disliking) Government. Readers of Nature will chiefly value Mr. Millais's book for the careful way the author has skimmed the published and private writings of Selous and his correspondents, such as Theodore Roosevelt, for notes on the life-history of the mammals of Africa and North America, and on the bird-life of the eastern Mediterranean countries.

H. H. Johnston.

PART-TIME EDUCATION IN THE UNITED STATES.

The sixty-fourth Congress of the United States approved on February 23, 1917, an Act to provide for the promotion of vocational education; for co-operation with the several States of the Union not only in the promotion of such education in agriculture and the trades and industries, but also in the preparation of teachers of vocational subjects; and to appropriate money and regulate its expenditure. There was thereupon set aside from Federal funds, first to aid in paying the *salaries* of teachers and directors of agricultural subjects sums of money annually, beginning with 100,000*l.* in 1918, and rising by annual increments to 600,000*l.* in 1926; and secondly, a like subsidy to aid in payment of the *salaries* of the teachers and directors of trade, home economics, and industrial subjects, to be distributed to the several States, as regards agricultural subjects according to the ratio which the rural population bears to the total rural population of the United States, and as regards the other subjects before-named in the proportion which the urban population bears to the total urban population of the United States. The Act further provides funds for the *training* of teachers and directors of agricultural subjects and also of the other subjects before-mentioned to the extent of 100,000*l.* in 1918, increasing to 200,000*l.* in 1921 and thereafter.

The Act is mandatory upon all the States of the Union, each of which must appoint either its existing Board of Education or a special State Board comprised of not fewer than three members to administer the Act in co-operation with the Federal Board for Vocational Education, which consists of seven persons—namely, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Labour, and the U.S. Commissioner of Education, together with three other persons representing the respective interests of agriculture, manufactures and industry, and labour, and assigns to each of these three a salary of 600*l.* They are to co-operate with the State Boards, and are empowered to make, or cause to be made, studies, investigations, and reports thereon with particular reference to their use in aiding the States in the establishment of vocational schools and classes, and in giving instruction in the various vocations—the inquiries to include processes and requirements affecting the various pursuits and those who follow them, as well as problems of administration of vocational schools, and the Act assigns for these purposes the annual sum of 40,000*l.*

The several State Boards are to submit plans for giving effect to the Act to the Federal Board, which, so far as they are in conformity with its provisions, will be approved. All vocational education aided by Federal funds shall be under public supervision and control, and moneys assigned in aid of the *salaries* of teachers and

directors of vocational education, and all moneys in aid of the *training* of teachers and directors, must be matched by an equal sum on the part of the State Boards, upon which bodies will fall all the initial and annual expense of buildings, equipment, and administration. The purposes of the Act are rigidly defined. They are to fit young persons for useful employment, the teaching is to be less than college grade, and is to meet the needs of persons of more than fourteen years of age engaged in agricultural, commercial, and industrial pursuits and in home economics. The Federal Board is to inquire and to report annually to Congress as to the administration of the Act throughout the States, and as to the expenditure, and to include therein the reports of the several State Boards.

This important Act of Congress, whilst it has many commendable features, does not require compulsory attendance on the part of young people engaged in employment at continuation or part-time schools. This is regarded as vital to the efficiency of the Act in a bulletin issued by the Federal Board for Vocational Education, in which it is stated that the initiative not only for establishing such schools, but also for compelling the attendance of those for whom the instruction is provided, must be taken by the States, and that it is not probable that State schemes for part-time education will develop materially until after the passage of legislation authorising and directing the establishment of such schools, providing State funds for their equipment and support, and compelling the attendance of the young people for whom they are designed within the ordinary working hours. It is officially stated in the bulletin referred to that out of a total population, male and female, between fourteen and eighteen years of age, of 10,250,000, 5,000,000 have ceased school attendance altogether. The only State of the Union which has adopted a real measure of compulsion for pupils between fourteen and sixteen years of age having work permits is Pennsylvania, under a law enacted in 1915, and already there are 100 school districts with 36,000 pupils in attendance at part-time continuation schools; but the movement is growing, and already there appears in Bulletin 19 a draft of a suggested new State law providing for compulsory part-time education and part-time employment for children between fourteen and sixteen.

The total *day-school* enrolment of the States in 1915 was 21,958,836, of which number 91 per cent. were in the elementary schools, 7·13 per cent., or nearly 1,566,000, in high schools, academies, and secondary schools, and 1·84 per cent., or about 404,000, in higher institutions—sufficiently significant figures when compared with those of the United Kingdom. The Federal Board sets forth in a most useful and illuminating bulletin six types of continuation schools: (*a*) The unit-trade school, which deals solely with the needs of a single trade, and into which, having settled upon his future employment, a young person can enter after fourteen years of age for a period of whole-time training of not less than thirty hours per week for not less than thirty-six weeks of the year, half the time to be given to practical work on a useful or productive basis, and the other half to related and non-vocational subjects; (*b*) the whole-time general industrial school for towns of fewer than 25,000 inhabitants on the same basis as the unit-trade school; (*c*) the part-time trade extension school within working hours for persons more than fourteen years of age already engaged in a trade occupation; (*d*) a part-time trade preparatory school for persons already in employment, but desirous of changing it; (*e*) a general continuation part-time school where opportunity would be given for the study of English, civics, home economics, and commercial subjects; (*f*) evening schools or classes for special trades and industries supplemental to day employment for persons above sixteen years of age.

The Federal Board has issued upwards of twenty important bulletins dealing with general policies and methods, agriculture and special trades and industries, different types of schools to suit differing localities and circumstances, measures for emergency training in various industries, training of vocational teachers, rehabilitation and re-education of disabled soldiers and seamen, and, finally, with buildings and the equipment necessary to give full effect to the Act. This series of publications is deserving of the closest study, as the principles and practice they embody are of general application. They should be consulted by every director of education, and be accessible in every reference library of the kingdom. The movements abroad in Germany and the United Kingdom are keenly watched by the executive of the Federal Board, and significant reference is made in the bulletins to recent legislation making compulsory complete attendance at school until fourteen years of age, extending elementary education by means of central schools, and establishing compulsory attendance at continuation part-time schools from fourteen to eighteen throughout Great Britain. A marked feature of the policy of the Federal Board is the insistence upon the avoidance of all vocational instruction in the elementary and secondary schools of the States.

THE FUTURE OF SCIENTIFIC INDUSTRIES.

THE report of the Engineering Trades (New Industries) Committee has recently been issued by H.M. Stationery Office (Cd. 9226, price 6*d*. net). The Committee was appointed, with the Hon. H. D. McLaren as chairman, to compile a list of articles either not made in the United Kingdom before the war, or made in insufficient quantities. A series of fifteen branch committees, consisting of producers and merchants, was arranged to give detailed consideration to groups of manufactured articles. They were required to make recommendations as to the prospect of set-

ting up new, or developing existing, industries, having regard to the financial facilities necessary for success.

The Committee recognises that many engineering firms in this country are threatened with serious financial trouble from the difficulty of raising new capital, and the pressure of the munitions levy and the excess profits taxation. It finds that in some branches the industry has not kept pace with the demands of customers, and that users have been driven to purchase more up-to-date machinery in foreign markets. The principal remedies for this appear to be more specialisation and standardisation in the production of individual firms. Both tend to facilitate manufacture in quantities and so reduce cost. The Committee also emphasises the importance of scientific and industrial research, and regards with satisfaction the formation of associations in some trades for that purpose, assisted by grants from the Department of Scientific and Industrial Research.

Over much of the field surveyed, the resources for production in this country appear to be adequate. But there are cases where articles which could well be manufactured here were, before the war, obtained wholly or in great part from abroad. To take a few examples. Milk-testing appliances were obtained exclusively from Switzerland. Germany had captured most of the trade in white-metal spoons and forks. Lathe and drill chucks, gear-cutting machines, and mechanics' fine tools were, to a large extent, imported from America and Germany. Precision measuring instruments were not adequately made in this country. Electrical insulating materials were, to a great extent, if not wholly, imported from abroad, and, although progress has been made in overcoming the deficiency during the war, the opinion of the industry is that much research work is necessary, and that for success the manufacture must receive State assistance.

The market for tool-room and precision lathes has been almost entirely in the hands of foreign manufacturers, and that for the remarkable class of watchmakers' lathes, with hundreds of interchangeable fittings, is wholly in the hands of German firms.

Some branches of industry, especially the electrical industry, complain of the effect of unrestricted imports. It is pointed out that the insecurity of the home market, due to the fact that foreign products can be introduced and sold at an unreasonable price, discourages the investment of capital, and seriously hampers the development of home manufacture. Foreign makers of electrical plant, protected in their home markets by tariffs, produce on a larger scale and lower cost than the British manufacturer; in face of such conditions the industry cannot be expected to thrive. Magnetos before the war were entirely produced in Germany. During the war they have been quite successfully made here. But the exclusion of German magnetos is demanded for a period after the war except under licence and with a duty on import. Protection or Government support is asked for in many cases. No doubt there are industries so important and so valuable as a means of training skilled workers that a claim of this kind is justified. The clock and watch manufacture seems to be such a case. But such claims must be carefully considered, in view of the fact that it is one of the objects of the Peace Conference to remove, so far as possible, all economic barriers.

It is clear from the report of the Sub-Committee dealing with scientific apparatus that the country has been backward in developing this vital industry, affecting research, education, and many other industries. The Committee recommends that for ten years scientific apparatus should not be imported except under licence, which should be granted and continued only so long as British apparatus is not available at reasonable prices. The following list gives some of the cases examined by the Sub-Committee: Balances and barometers largely obtained from Germany and sold under the names of English dealers; photographic apparatus supplied in large numbers by Germany and the United States; dividing engines supplied chiefly by Switzerland; drawing instruments derived chiefly from Germany; micrometers and measuring instruments largely supplied by the U.S.A.; physical apparatus obtained from Germany and sold under the names of English dealers; photographic lenses, which formerly came from Germany and France, might be manufactured here; also microscopes supplied largely from Germany.

It is stated that there are classes of articles imported which are made in such large quantities, and have such manufacturing and inventive resources behind them, as to make competition extremely difficult. In such cases, if the manufacture is to be developed in this country, it appears to be necessary that State assistance should be given towards overcoming the difficulty of competition. It is also recommended that Government Departments and public authorities should make it a practice to place orders for standard goods of British manufacture, and also have in view the desirability of encouraging the production of articles of new and improved types.

DR. HENRY WILDE, F.R.S.

Dr. Henry Wilde, whose death was announced in Nature of April 3, was a man of remarkable individuality and a pioneer in electrical engineering. He was born in Manchester in 1833. During his apprenticeship he experimented with voltaic cells, electrical machines, electrical kites, and the electro-deposition of metals. He soon realised the great commercial possibilities of the applications of electricity, and he decided, when he was twenty-three years of age, to commence in business as a telegraph engineer and lightning-conductor expert. Several years were devoted to the invention of a magneto-electric alphabetic telegraph. Experiments with elec-

tro-magnets led to the design of an improved electric generator described in his patents of 1863 and 1865. Wilde's "dynamo-electric machines"—as they were named by Charles Brooke, F.R.S.—quickly replaced batteries for electro-deposition and arc lighting, but in use they had the serious disadvantage of becoming very hot. In the endeavour to cure this fault Wilde designed a very different type of dynamo. This was a multipolar machine, with sixteen pairs of electro-magnets, which was made self-exciting by a "minor" current from four of the armature bobbins. Both this and the earlier machine were used by Elkington for the electrolytic refining of copper.

Wilde directed his attention to the use of his generators for other electro-chemical purposes. He obtained a patent in 1871 for protecting iron tubes from corrosion by coating them with copper, and four years later he introduced a valuable process for making by electro-deposition rollers of copper used in calico printing. With a revolving cathode he was enabled to employ relatively high current densities, and yet obtain a good quality of copper. This invention proved to be financially the most valuable of all his patents.

Experiments with two of the multipolar machines led to the discovery in 1868 that it was possible to run them, when in synchronism, as alternators in parallel. The importance of this was not realised until fifteen years later, when Dr. John Hopkinson, unaware of the work of Wilde, showed that this was theoretically possible, and now the parallel running of alternators is an everyday occurrence at supply stations.

Wilde designed direct- and alternating-current arc lamps suitable for search- and light-house purposes. Some large battleships were equipped with these under his direction, and after the *Titanic* disaster he strongly urged that mercantile vessels should be fitted with searchlights.

In 1884 Wilde retired from his business as an electrical engineer. During the remainder of his long life he chiefly devoted himself to special scientific subjects. He published a number of papers relating to atomic weights, and invented a magnetarium for reproducing the phenomena of terrestrial magnetism.

Wilde was a considerable benefactor to public institutions, amongst which must be especially mentioned the Literary and Philosophical Society of Manchester. Including the Wilde endowment, his contributions to the society exceeded 10,000*l.* He died at The Hurst, Alderley Edge, Cheshire, where his wife also died twenty-six years previously. He had no children. After some legacies, the residue of his estate has been bequeathed to the University of Oxford. W. W. H. G.

NOTES.

THE projected Atlantic flight is naturally exciting considerable interest at present, but it has recently been bad flying weather, and large storm systems have been sweeping eastwards across the ocean. For the flight to be safe and successful such disturbances must be avoided. In a statement issued on Monday by the Air Ministry relative to the weather factor of the flight, estimates were given of the time required for the flight eastwards and westwards between Newfoundland and Ireland under favourable and adverse conditions during the months of April, May, and June. The report states "that in every case weather conditions are more favourable for flying from Newfoundland to Ireland than from east to west, and that it would on certain occasions be impossible to accomplish the journey in the latter direction." It is not easy to see how the Air Minstry has used the available data, and there must necessarily be a great element of doubt meteorologically. The aeroplane flying eastwards will travel about four times as fast as the average easterly translation of an Atlantic storm, and may quite easily overtake at least one storm. A storm, on an average, takes four or five days in crossing the Atlantic from shore to shore; it may, however, be developed in mid-ocean and start its passage eastwards, and when nearing the European side the track of the storm may quite possibly be to the northward. The upper air generally has a quick movement to the eastward. So far as possible, for a successful air passage choice should be made of a period when the Atlantic is comparatively free from important storm areas; such periods exist, but under the present conditions indefinite waiting has its drawbacks. Meteorologists can scarcely favour an attempt to fly westwards until further experience is gained of the movements of the upper air.

WIRELESS telephony is being installed in the Folkestone-Cologne aerial mail service. Along this route a chain of call-stations is being erected, and the aeroplanes engaged in the service are being fitted with both sending and receiving sets. In practical tests it was found that clear voice signals were transmitted from 'plane to ground, and *vice versa,* at a distance of thirty miles. By operating a simple switch the connections are changed from "send" to "receive." A certain amount of voice-training is desirable, otherwise the voice may be drowned by the engine drone. The operator in the aeroplane wears a carefully fitted helmet with ear-receivers. It is necessary that complete freedom of movement should be ensured and all wind-noises eliminated. At present specially trained men are employed to fit on the helmets. Improvements are continually being effected in the methods and apparatus, so that the complete practical transmission of speech between aeroplanes and ground stations is assured.

No profession is free from its obscurantists, and the little band of half a dozen medical men who serve the anti-vivisectionist agitation have once again written to the *Times* to declare their conviction that experiments on dogs are unnecessary for the advance of medical science. Such a letter, devoid as it is of authority, serves a useful purpose in emphasising the weighty character of the resolution recently passed at the meeting of the British Medical Association, when the combined sections of medicine, pathology, and preventive medicine expressed their opinion, without a single dissentient, that the prohibition of experiments upon dogs would hamper the progress of medicine, and render Britain alone among civilised nations unable to contribute to progress in a department of medical research in which it has hitherto played a distinguished part. The Royal College of Physicians has also recorded its opinion "that the passing into law of the Dogs Protection Bill, now before the House of Commons, will greatly retard the progress of our knowledge with regard to the prevention and treatment of disease." The supporters of the Bill, to judge from their letters in the Press, are annoyed at the statement made by men who actually carry out

experiments that, as the law is at present administered, it is impossible for dogs to suffer pain. They point to the power possessed by the Home Secretary of allowing painful experiments upon dogs, and see in this a proof that pain is inflicted. It is right and just that such powers should be possessed. Even though for the large majority of experiments infliction of pain is unnecessary, and, indeed, a disadvantage from every point of view, it is always possible that research into certain diseases might involve the necessity of inflicting pain; and in such cases the interests of a dog, as of any other animal, may reasonably be subordinated to those of man. It seems pitiful that there should be all this pother and expenditure of valuable energy just because the Government, which spends thousands annually on medical research, was lacking in the courage or the foresight to declare at the outset that in the interests of the community the Bill could not be allowed to become law. It is to be hoped that, even at this late hour, the Government will take a definite stand in the matter and relieve the investigators and the medical profession from the need of wasting their time in defending science and the welfare of the community against the attacks of misguided zealots.

The funeral of Sir William Crookes took place in Brompton Cemetery on Thursday, April 10, and was preceded by a service held at St. John's Church, Notting Hill. The three sons and one daughter, together with other members of the family, were present. Most of the learned societies in London were represented, among them being:—Royal Society, Sir J. J. Thomson, Prof. A. Schuster, and Prof. Emerson Reynolds; Royal Institution, the Hon. R. Clere Parsons; Chemical Society, Sir William Tilden and Dr. Alex. Scott; British Association, Prof. John Perry; Institution of Electrical Engineers, Mr. C. H. Wordingham, Col. R. E. Crompton, Mr. W. M. Mordey, and others; Society of Chemical Industry, Prof. Frank Clowes and Mr. J. P. Longstaff; British Science Guild, Sir Boverton Redwood and Lt.-Col. W. A. J. O'Meara; Institute of Chemistry, Sir Herbert Jackson and Mr. R. B. Pilcher; Faraday Society, Sir Robert Hadfield and Mr. F. S. Spiers; Institute of Inventors, Mr. W. F. Reid; Society of Psychical Research, Sir Lawrence Jones; Notting Hill Electric Light Co., of which Sir William Crookes was chairman for many years, the secretary, Mr. Rawkins. There were also present Sir William Davidson (Mayor of Kensington), Dr. Abraham Wallace, Prof. H. E. Armstrong, and many other distinguished men of science. A letter of condolence from his Majesty the King has been received by the family, and messages of sympathy have been sent by many prominent people in the world of science and literature who knew and valued the work of Sir William Crookes.

Prof. F. Morley has been elected president of the American Mathematical Society, and Prof. H. E. Slaught president of the Mathematical Association of America.

The sum of 100*l*. has been voted by the Rumford Committee of the American Academy of Arts and Sciences to Prof. A. G. Webster, of Clark University, in aid of his researches in pyrodynamics and practical interior ballistics.

Dr. J. W. Scott Macfie has been presented with the Mary Kingsley medal of the Liverpool School of Tropical Medicine in recognition of his distinguished services in research into tropical medicine and allied subjects.

Prof. J. H. Jeans will deliver a lecture entitled "The Quantum Theory and New Theories of Atomic Structure" at the ordinary scientific meeting of the Chemical Society to be held at Burlington House on Thursday, May 1.

The work on vulcanology at Kilauea has been placed under the U.S. Weather Bureau. We learn from *Science* that the transfer was made on February 15, and the appointment of the director, Prof. T. A. Jaggar, has been approved. A grant of 2000*l*. for the year is made by the U.S. Government for continuing the work heretofore maintained by the Volcano Research Association.

Mr. J. A. Cairns Forsyth has been awarded the Jacksonian prize for 1918 by the Royal College of Surgeons for his dissertation on "Injuries and Diseases of the Pancreas and their Surgical Treatment." The college has accepted an offer from the Barbers Company to endow for five years an historical lecture in anatomy or surgery, to be called the "Thomas Vicary Lecture," the appointment of the lecturer to be in the gift of the college.

On and after May 1 the library of the Chemical Society will be open daily from 10 a.m. until 9 p.m., with the exception of Saturdays, when it will be closed at 5 p.m. This further extension of the hours of opening has been made possible by the co-operation of the Society of Chemical Industry, the members of which are now able to use the library in common with the members of the societies mentioned in Nature of December 19 last (p. 310).

Mr. A. J. Walter, K.C., whose death occurred on April 9, was one of the best known members of the Bar in connection with patent actions. He was a man of science as well as an able advocate, and this rare combination secured for him a high reputation in patent trade-mark and technical litigation. He carried out many valuable experiments in chemistry and electricity in his private laboratory, and was thus often able to astonish expert witnesses with first-hand knowledge of importance relating to the points at issue. Mr. Walter had served on the council of the Institution of Electrical Engineers, and his death deprives, not only the Bar of a distinguished leader, but also science of a keen student.

The Faraday Society and the Röntgen Society are holding a joint general discussion on the examination of materials by X-rays on Tuesday, April 29, at 5 p.m. in the rooms of the Royal Society. Sir Robert Hadfield, president of the Faraday Society, will introduce the discussion, and also contribute some papers, and an address on radio-metallography will be delivered by Prof. W. H. Bragg. Other contributors include Major G. W. C. Kaye, Capt. R. Knox, and M. E. Schneider (Le Creusot). The discussion will include contributions on the examination of timber as well as of metals by X-rays, and there will be exhibits of apparatus and demonstrations by M. Pilon, Major C. E. S. Phillips, Mr. Geoffrey Pearce, and others.

Dr. Louis A. Bauer has finally selected Cape Palmas, Liberia, as his observing station for magnetic and electric observations in connection with the solar eclipse of May 29. He will be assisted by Lieut. H. F. Johnston, who has rejoined the staff of the Department of Terrestrial Magnetism, having been on duty during the war at the Admiralty Compass Observatory at Slough. The party sailed on the steamer *Benue* from Liverpool on April 12. Mr. Frederick Brown, at one time assistant at the Royal Observatory, Greenwich, has been sent by Dr. Bauer

to Duala, Cameroons; he sailed from Liverpool on April 9. Mr. Brown, in addition to magnetic survey work in West Africa, will make special magnetic observations during the eclipse at a station as near as possible to Ile Principe or Libreville.

THE death of Dr. Bruno Hofer on July 7, 1916, at the age of fifty-four years, is announced in German fisheries papers that have just been received in this country. Dr. Hofer had attained a great reputation as a fisheries biologist; he was director of the Royal Bavarian Biological Experimental Station for fresh-water fisheries at Munich, and was for many years editor of the *Allgemeine Fischerei-Zeitung*. The exploitation of carp and other lake and river edible fishes was of great value to Germany, and was the subject of much sound economic and scientific research. Dr. Hofer's book, "Handbuch der Fischkrankheiten," was well known here; it broke entirely new ground in its treatment of the pathology of fresh-water fishes, and, in spite of its rather limited scope, still remains the only compendium on the subject.

THE following are among the subjects of lecture arrangements at the Royal Institution after Easter:—Prof. Arthur Keith, British Ethnology: The People of Wales and Ireland; Prof. W. H. Bragg, Listening under Water; Dr. H. S. Hele-Shaw on clutches; Prof. F. Keeble on intensive cultivation; Sir Valentine Chirol, The Balkans; Prof. H. S. Foxwell, Chapters in the Psychology of Industry: (1) Fourier and other Pioneers in the Movement for the Humanising of Industry; (2) Modern Industrial Organisation: Where it Fails to Observe the Humanities of Industry, and the Results. The Friday evening meetings, at 5.30 o'clock, will recommence on May 2, when Prof. J. W. Nicholson will deliver a discourse on energy distribution in spectra. Succeeding discourses will be given by Sir George Macartney, Dr. S. F. Harmer, Sir Alexander C. Mackenzie, Sir John Rose Bradford, and Sir Ernest Rutherford.

A NOTE on German and English war-time diets is contributed to the Journal of the Royal Statistical Society (vol. lxxxii., part 1, January) by Dr. Major Greenwood and Cicely M. Thompson. From the records of German towns, according to Government statistics, the average food-value in that country was 2352 Calories per head per day in April, 1916, and 2007 in April, 1917. In June, 1917, the corresponding averages of six canteens and hostels in Great Britain were 3168 and 3073 Calories, while in April, 1918, the averages for three women's munition hostels were 2782 and 2699 Calories per head per day. It should, however, be noted that the German statistics referred to the consumption of food in ordinary families, and this and other circumstances preclude any attempt at a very exact comparison of the conditions of living.

THE Italian Society for the Progress of the Sciences is holding its tenth meeting at Pisa on April 14–19 under the presidency of Prof. Fernando Lori. Unlike our British Association, the proceedings very largely centre round developments of economic importance, and the majority of the papers are divided into three classes: Class A, dealing with mining, mineralogy, and geology; Class B, with agriculture, medicine, fisheries, and biology; and Class C, with economics and political science. A few sectional papers on other branches of science are included in the programme, which opened on Monday, April 14, in the *aula magna* of the University of Pisa with a discourse by Prof. Raffaello Nasini on Italy's mineral wealth. Friday and Saturday, April 18 and 19, are to be devoted to excursions. The ordinary subscription is ten francs, and the offices of the society are at 26 Via del Collegio romano, in Rome.

THE conference representing Allied Red Cross Societies now meeting at Cannes has held important meetings on venereal disease, on tuberculosis, and on malaria. As regards venereal disease, there was a general agreement that some uniform action is needed —as, for example, on such subjects as the control of prostitution and on notification of the disease. Similarly with tuberculosis, there was unanimity of opinion that a common scheme of action is necessary throughout the world on the lines which have been adopted in this country, and also to a large extent in the United States. As regards malaria, Prof. Castellani gave some interesting figures on the control of malaria in four camps in the Adriatic zone. In one camp no anti-malarial measures were taken; in the second, preventive doses of quinine were given; in the third, anti-mosquito measures were employed; and in the fourth both quinine and anti-mosquito measures were used. The results were that the following percentages of the occupants were affected with malaria:—In the first camp, 100 per cent.; in the second, 45 per cent.; in the third, 25 per cent.; and in the fourth, only 6 per cent.

THE British Photographic Research Association, which was incorporated nearly a year ago under the presidency of Sir J. J. Thomson, has just issued a "Programme of Research," in which it is announced that Dr. R. E. Slade has been appointed the director of research, and that he and his staff will work for the time being in laboratories at University College, London. The laboratories assigned to them are distinct from the teaching laboratories. The fundamental subjects that it is intended to investigate include the properties of silver haloids, the properties of gelatin and similar colloids, colloidal chemistry in general, photo-chemical reactions, and the theory of colour-photography processes. Among the subjects of applied research will be desensitising and reducing agents, gelatin (seeking for the causes of the effects of various samples and to obtain standardisation and improvement of the material), photographic apparatus (the treating of wood, canvas, and leather, and the production of special alloys), enamels, paper, cardboard, and colour photography. The association welcomes inquiries from its members on technical points, and will endeavour to reply helpfully. But it is not the intention of the association to attempt to standardise throughout the manufacturing methods of the photographic industry, as manufacturers will continue to determine for themselves the lines on which their businesses shall be developed. It is very truly added that the programme covers a vast field for research, but it is hoped to explore first the most productive portions of this field. It is encouraging to everyone concerned to be assured that results have already been obtained which it is expected will have a wide application in the industry.

THE bark of the locust tree (*Robinia pseudacacia*) is poisonous when eaten by horses and cattle. A toxic albumose is present in it, and a toxic glucoside, named "robitin," has now been isolated by B. Tasaki and U. Tanaka (Journal of the College of Agriculture, University of Tokyo, vol. iii., No. 5, p. 337). In the fresh bark 1 per cent. of the glucoside is present, and toxic reaction is caused by a dose of 0·0015 grm. in the horse and 0·02 grm. in cattle. The reaction caused by the injection of "robitin" into the horse is exactly that produced by the fresh bark, and consists in dyspnœa, increase of secretions and excretions, and paralysis of the hindquarters.

THE Board of Agriculture and Fisheries has issued as a Supplement (No. 18) to the *Journal of the Board of Agriculture* a series of articles dealing with the

cultivation, composition, and diseases of the potato. The various sections of the Supplement deal with potato-growing, the food value of the crop, potato diseases, the causes of decay in potato clamps, potato-spraying, variety tests, and the Wart Disease Order. As a compendium of information on these various phases of the subject the Supplement should prove of great interest and value to growers of potatoes, whether on a large or a small scale. The sections dealing with diseases and disease-resisting varieties form the main features, and are well illustrated by coloured plates and photographs.

In the March issue of the *Journal of the Board of Agriculture* Dr. W. E. Collinge reports the results of further investigations on the food of wild birds. The observations, together with those previously reported, are based upon the examination of the stomach and crop contents of 4468 adult birds and 761 nestlings, embracing seventeen species of wild birds. On the basis of these observations two species appear to be distinctly injurious, viz. the house-sparrow and the woodpigeon. Three species are too numerous, and consequently injurious, viz. the rook, sparrowhawk, and starling. One is locally too numerous, viz. the missel-thrush. Three species are distinctly beneficial, but do not warrant special protection, viz. the jackdaw, yellow bunting, and song-thrush. Seven species are so highly beneficial that their protection is advisable, viz. the skylark, green woodpecker, kestrel, lapwing, great tit, blue tit, and fieldfare. With regard to the chaffinch the opinion is expressed that, in spite of the injuries it commits, it would be unwise to adopt repressive measures.

In relation to an inspection of the Sheffield City Museums which he made in 1915, Dr. F. Grant Ogilvie has now issued a report on the subject. While the report deals with Sheffield museums in particular, it will be of value to all local authorities in indicating the lines on which they should develop local museums, especially in industrial centres. The recommendations regarding municipal interests and science and industry are particularly worthy of attention. Among municipal interests should be maps, plans, and models illustrating the local topography, resources, occupations, public works and services, both in the present and past. In fact, this section should comprise a complete survey of the town and neighbourhood. The value of such collections to the architect and town-planner is obvious. They would also serve to give residents a better understanding of their own town, and so might promote the growth of civic consciousness. Dr. Ogilvie's report, however, is severely practical, and, besides discussing the value of the collections he proposes, he indicates what objects should be included and how they can be best displayed. The advice given to details of space and housing is very valuable. The report is issued by the Board of Education as No. 34 of its series of educational pamphlets.

We have received a copy of the convention between the United States and Canada for the protection of migratory birds. The convention, with an introduction and explanatory notes, is published by the Department of Agriculture, Ottawa. The provisions and regulations of the convention show that it is probably the most important and far-reaching measure ever taken in the history of bird protection. It affects more than a thousand species and subspecies of birds from the Gulf of Mexico to the North Pole, and should lead in a few years to a great increase in the numbers of several species of considerable economic importance. All migratory insectivorous and migratory non-game birds and their eggs are permanently protected, with the exception of certain species which Indians and Eskimo are allowed to take for food, but not for sale. Shore-birds and waders, with a few exceptions, are protected for ten years, and the same protection is given to cranes, swans, and curlew. Wood-duck and eider-duck are protected for five years. Close seasons, varying in different parts, are instituted for wildfowl and other migratory game birds. The convention contains provisions by which specimens of birds and eggs may be secured for scientific purposes, but it is clear that permission will be granted only after careful investigation. Local modifications in the convention may be made in the case of birds which prove injurious to agricultural interests.

An account of a five months' journey in Colombia, down the Magdalena River, and through the north-east of the Republic, is described in a pamphlet by Mr. M. T. Dawe, agricultural adviser to the Colombian Government. The pamphlet is published in English by the Ministry of Agriculture, Bogota. Mr. Dawe's object was to report on the agricultural possibilities of the region and the occurrence of coal. The article, besides discussing very fully the suitable crops, labour conditions, and transport requirements, contains a great deal of useful geographical information about a little-known region. Mr. Dawe was particularly struck with the stock-raising possibilities of the Goajira peninsula, which has an area of about 4000 sq. miles. Being fairly high and almost surrounded by the sea, the peninsula has a healthy, if rather dry, climate. There are large regions of good pasture-land, of which 90 per cent. is still unoccupied. Artesian wells would have to be sunk to supplement the water supply. Cotton and ground-nuts could also be cultivated in the peninsula. The present inhabitants are some 40,000 Indians, who are steadily emigrating to Venezuela for lack of industries to keep them at home. The Sierra Nevada is another region well suited for colonisation; fruit-growing offers good prospects of success. Speaking generally of these districts and the whole of the Magdalena province of Colombia, Mr. Dawe advocates the encouragement of Japanese colonisation, which he holds has been successful under comparable conditions in Brazil. He does not explain why emigrants from Mediterranean Europe would not be suitable.

Mr. R. S. Whipple read two interesting papers on "Electrical Methods of Measuring Body Temperatures" and "The Electro-Cardiograph" before a joint meeting of the Institution of Electrical Engineers and the Royal Society of Medicine on March 21. In the former paper Mr. Whipple arrives at the conclusion that a continuous record of the temperature of the human body can be best obtained by an electric thermometer placed in the rectum. For very accurate research work a thermo-electric couple can be used in conjunction with a photographic recorder. The electrocardiograph utilises the discovery first made by Prof. Waller that the electric potentials developed in the heart at each contraction of the organ were sufficiently large to deflect a sensitive galvanometer. The cardiograms shown by the lecturer were exceedingly instructive, and it was easy to believe that they have a great and growing value in medical practice.

At the meeting of the Royal Photographic Society held on February 18, Mr. S. H. Williams described his new process of printing on paper in natural colours, and showed several examples. Mr. Williams makes one plate and one exposure serve for the three colour records by exposing it behind a screen that has 540 lines to the inch, the lines being alternately red, green, and blue, and of equal widths. By placing over this negative a key-plate that is ruled with black

lines of double width and with single-width spaces, that portion exposed behind each colour may be alternately isolated as the key-plate is shifted. This adjustment is done mechanically, identification marks indicating which colour record is exposed, and as contact prints cannot be obtained, an enlarging lantern is used. The prints may be obtained "in any one of a dozen different ways," but Mr. Williams prefers the bromoil process, inking up with the three necessary colours and superposing the prints by transferring the ink images to drawing-paper. The lines are not obtrusive in the resulting pictures, and, if desired, they can be obliterated by putting the image slightly out of focus when making the exposures for the prints. The method of making the screens is also described in the *Photographic Journal* for March.

In an address to the Franklin Institute, Philadelphia, which is reproduced in the Journal of the institute for January, Mr. H. Leffmann shows that the pioneer experiments in aviation carried out by the late Prof. S. P. Langley were complete enough to form the basis for modern practice. In May, 1896, Prof. Langley launched from a small island in the Potomac an unmanned aeroplane driven by a steam-engine which ascended to an altitude of 60 ft. or 70 ft., and travelled at about twenty miles per hour for eighty or ninety seconds before descending. With the help of a grant from the Government and the mechanical assistance of Mr. C. M. Manly, he constructed an internal-combustion engine of 18 b.h.p. weighing only 108 lb., and in 1903 Mr. Manly made an experimental flight on a machine driven by this engine. Through some accident not clearly understood, the flight came to a premature conclusion, and the pilot narrowly escaped drowning. Prof. Langley died in 1907 without making any further experiments, but in 1914 the machine of 1903 was flown successfully by Mr. G. H. Curtiss. When the engine was replaced by one of 80 h.p. a number of flights were made which demonstrated that the principles of the Langley machine were sound and practical.

The *Cambridge University Press* is publishing for Dr. A. E. Shipley, Master of Christ's College, and Vice-Chancellor of the University of Cambridge, an account of the author's experiences during his recent visit to the United States of America. It will be entitled "The Voyage of a Vice-Chancellor." "The Furniture Beetle" is in preparation for appearance in the series of Economic Pamphlets of the British Museum (Natural History), and "The Danger of Disease from Fleas and Bugs" for appearance in the Museum's series of Economic Leaflets. *Mr. W. Heinemann* is about to publish "Psychology and Parenthood," by H. A. Bruce, who aims at presenting to parents particulars of the discoveries in child-nature obtained by psychologists and others. *Messrs. Longmans and Co.* announce a book which should be of interest to educationists, viz. "The Manchester Grammar School, 1515–1915: A Regional Survey of the Advancement of Learning since the Reformation." The author is Dr. A. A. Mumford.

OUR ASTRONOMICAL COLUMN.

Observed Changes on Jupiter.—Some remarkable alterations in the surface-markings of this planet have been observed recently. The bay or hollow in the south equatorial belt, which has been almost uninterruptedly visible since Schwabe figured it in September, 1831, appears to have disappeared. Mr. F. Sargent, of Bristol, using telescopes of 10½ in. aperture (reflector) and 5 in. (Cook refractor), has been unable to see any distinct traces of the feature named during his very recent observations. It was an important marking as serving to show the position of the great red spot, which has been very faint during a long series of years. In 1901 a large dark mass made its appearance in the south tropical zone of Jupiter, and in about the same latitude as the red spot. This moved with greater speed than the latter, its rate of rotation being about 12 seconds less, and the marking had so greatly extended in longitude that in January and February of the present year it ranged over about 180°, or half the planet's circumference. This object seems also practically to have disappeared. Mr. Sargent saw the following end of it central on March 7 at 10h. 13m. in longitude 60·3°, but it was extremely faint, and regarded as near the vanishing point. Since that date observations have failed to reveal the object, though the disc has been carefully scanned at those times when it must have been presented to view had it continued visible.

Drawings of Mars.—*Popular Astronomy* for February contains an interesting series of comparative drawings made by five observers at the last opposition, according to a prearranged scheme organised by Prof. W. H. Pickering. On the whole, the accord of the different draughtsmen is satisfactory; thus of 131 canals appearing on the sketches, eighty-three are confirmed by at least one other observer. The Rev. T. E. R. Phillips noted that he could see nothing with the Greenwich 28-in. that was not visible in his own 8-in. Several observers mention the beautiful blue tint of Syrtis Major; the other maria tended to grey or brown.

The Gegenschein or Counterglow.—This phenomenon has a great fascination for Prof. Barnard, who in 1899 published his observations extending over sixteen years. Prof. Barnard made another series last autumn (which he states to be the best season to observe it), and gives the results in *Popular Astronomy* for February. As in the previous set, the longitude comes out exactly 180° from the sun, the latitude 0·3° N. The diurnal parallax appeared to be insensible. He favours the explanation that it is an atmospheric phenomenon, the earth's atmosphere acting as a spherical lens and concentrating the sun's light. He mentions two other explanations as possible: that of Evershed, that the earth has a tail like a comet; and that of Moulton, that there is an aggregation of meteoric bodies at the point opposite the sun describing periodic orbits under the combined action of sun and earth.

Tycho Brahe's Original Observations.—An article by Dr. J. L. E. Dreyer in *Scientia* for March states that the manuscript books in which Tycho's observations were entered night by night were sold to the King of Denmark, and are now in the Royal Library at Copenhagen. A contemporary fair copy of most of them is now in the Imperial Library at Vienna, and from this copy an edition was prepared by a Jesuit named Curtius in 1666. This is known to be very incomplete and incorrect, and a new edition is being prepared by Dr. Dreyer from the original observing books and from the copy at Vienna, which will form vols. x.–xiii. of the collected works of Tycho Brahe, now being printed at Copenhagen.

THE DEVELOPMENT OF AIRSHIP CONSTRUCTION.

Among the important papers read last week at the Institution of Naval Architects was one on airship construction by Mr. C. I. R. Campbell, who has been responsible at the Admiralty for the design of our airships. In British practice it is assumed for design purposes that the gas has a lift of 68 lb. per 1000

cubic ft. The author gives a curve showing the average lift per unit volume of gas at various altitudes as a percentage of the lift at ground-level. A dominating requirement in design is the provision of the longitudinal strength necessary to withstand the longitudinal shearing forces and bending moments, and the different means adopted to meet this requirement divide airships into three main types, viz. non-rigids, semi-rigids, and rigids. Particulars of three non-rigid airships are given in the paper, having gross lifts of 4690 lb., 14,100 lb., and 11 tons respectively; the disposable lifts when full are 1669 lb., 4655 lb., and 5 tons. For airships larger than 500,000 cubic ft. the non-rigid type can be, and has been, used, but its efficiency tends to compare less favourably with the semi-rigid type as size is increased. The author deals with questions of the gas pressures required to enable the envelope of the non-rigid ship to maintain its form under the distorting forces due to weights, and with the means for supporting the bow against the external air pressure in flight. He considers that non-rigid ships form a class of great utility, which can be given speeds of 45 to 60 miles per hour, with disposable weight percentages from 33 to 45 per cent. They are particularly suitable for short-distance flights and for patrol duties. Their chief merits are simplicity, ease and cheapness of production, and low cost of maintenance.

In semi-rigid airships a longitudinal keel girder is fitted to the underside of the envelope so as to constitute a rigid or slightly flexible backbone. The general effect of the keel is to relieve the envelope of all loads which in non-rigid airships have to be met by means of a relatively high internal gas pressure. As a result it is found possible to fly large semi-rigid airships of more than 600,000 cubic ft. with gas pressures at the axis little more than one-half as great as those required in non-rigids of equal capacity and speed. Particulars of four semi-rigid airships are given in the paper, having volumes up to 1,060,000 cubic ft.; the type in recent years has been developed by the Italians alone. Semi-rigid airships fill the gap between the largest efficient non-rigid and the smallest useful rigid airship.

In rigid airships the whole of the shearing forces and bending moments are sustained entirely by a rigid hull. A typical rigid airship has the following characteristics:—643 ft. long by 78 ft. 9 in. extreme diameter; gas-bag capacity, 1,950,000 cubic ft.; maximum speed, 60 to 65 miles per hour; total lift, 59·2 tons under standard conditions; disposable lift, 30 tons. The machinery weighs 8½ lb. to 9 lb. per brake-horse-power. The author gives curves of shearing forces and bending moments for an airship of this type, both in the fully loaded and in the light condition, and discusses the effects of these curves on the design.

The most striking improvement in the commercial value of airships is to be obtained by increased size. An airship of 2,500,000 cubic ft. capacity, maximum speed 70 miles per hour, would have a disposable lift of 50 per cent. of the total, *i.e.* about 38 tons. To enable this ship to cross the Atlantic at 55 miles per hour she should carry fuel and oil for 4500 miles, and an analysis of the disposable weights shows that there are 8½ tons available for carrying capacity for passengers, luggage, food, etc., which is about 11 per cent. of the total lift.

If an airship of double capacity, *i.e.* 5,000,000 cubic ft., be designed for the same length of voyage, the carrying capacity works out to about 28 tons, which is about 18½ per cent. of the total. The running costs of the larger ship will be less than double those of the smaller, and hence the larger ship is a far better commercial proposition.

There are, of course, many problems other than those of design to be considered in the commercial airship. Thus Lord Weir directs attention to the cost of accommodation, the handling facilities, and the gas-producing plant. The question of mooring airships in the open is also being investigated, and it is hoped that it will shortly be possible to bring airships successfully to rest in the open even in a strong wind.

EXPERIMENTS IN PSYCHICAL RESEARCH.[1]

IN 1912 Mr. Thomas Welton Stanford, brother of Leland Stanford, and one of the trustees of the Leland Stanford Junior University of California, placed at the disposal of the University the sum of 10,000*l*., the interest on which was to be applied to investigations in the field of spiritualism and psychical research, and Dr. Jordan, the president of the University, asked if the department of psychology was willing to assume the responsibility of applying the endowment to work in this field. After some natural hesitation and consultation with other universities, the offer was accepted. The endowment sufficed not only to refit and equip the laboratory rooms assigned to the work, but also to defray the expenses of a fellowship, to which Dr. Coover, a trained psychologist, was appointed. The present bulky volume constitutes his first report.

Part i. deals with the hypothesis of "thought transference" or telepathy, a subject on which much experimental work has been done, but more, and more carefully controlled, work was urgently needed. Three sets of experiments were carried out:—(1) On the guessing of lotto-block numbers; (2) on the guessing of playing-cards; (3) on the "feeling of being stared at." The playing-card experiments were very extensive, and deserve a longer notice than we can give them. The following was the method:—(i) The experimenter shuffles the pack (court cards discarded). (ii) He throws a die. If the number thrown is odd he holds the card in his mind, the form of content being: for 1, visual impression; for 2, kinæsthetic imagery (incipient pronouncing); for 3, combined visual impression, kinæsthetic image, and auditory image. (For even numbers, see below.) (iii) He turns over the pack, notes the bottom card, taps once to signal the reagent, holds mental content of card, and "wills" the content to be projected into the mind of the receiver. After fifteen or twenty seconds he taps twice to signal the close of the experiment, and, when he notes that the reagent has recorded his guess, himself records colour, number, and suit of the card and number of the die determining the form of the experiment. When the die threw an even number the experimenter ran off the rest of the experiment as usual, but *did not look at the card until the reagent had recorded his guess*, thus affording an effective series of control experiments. The results of 10,000 guesses with University students, favourably disposed, were entirely negative. No statistical analysis shows any deviation in the percentage of right cases exceeding the probable limits of pure chance, or any tendency for the guesses to be more correct when the reagent graded his answers high (indicating considerable confidence that they were right) than when he graded them low. A further set of experiments was made with ten "sensitives," five of them "spiritistic mediums," persons with a sincere faith who gave time and effort to the research without pay. The statistical

[1] Leland Stanford Junior University Publications. Psychical Research Monograph No. 1, "Experiments in Psychical Research at Leland Stanford Junior University." By John Edgar Coover, Fellow in Psychical Research and Assistant Professor of Psychology. Pp. xxiv+641. (Stanford University, California, 1917.) Price, paper 3.50 dollars, buckram 4 dollars.

analysis of the results of 1000 experiments revealed no advantage for psychics over normal reagents; there were no deviations in right guesses beyond the limits of chance.

The experiments conducted to test the common belief in sensitiveness to being stared at were equally negative in their results, "regular" and "control" experiments being determined in the same way by the throw of a die. A shorter series, in which a single "starer" was replaced by twelve "starers," gave no more definite result. In this series the twelve "starers" were told in the control experiments to image a black cat on the lecture-table. None of the reagents ever thought of black cats.

In part ii. of the volume previous evidence as to the influence of subliminal impressions on judgment is reviewed and the results of some further experiments are given (guessing letters and digits presented by a tachistoscope, influence of whispering, influence of involuntary signals, *e.g.* eye-movements of an experimenter who had a definite number-form). The experiments showed, generally speaking, evidence of that "fringe of perceptions, most often unconscious, but all ready to enter into consciousness, and, in fact, entering in in certain exceptional cases or in certain predisposed subjects," with which Bergson has insisted that "psychical research could and should concern itself." And it seems more than probable that this sort of perception has played a *rôle* in the evidence for telepathy, as others have even more definitely asserted.

After a discussion in part iii. of the influence of mental habit upon judgment, and of the confirmation by experiment of results obtained by the theory of probability—matter which we should prefer to have seen given in an introductory chapter—the author passes in part iv. to an account of some interesting experiments in "sound-assimilation," *i.e.* the tendency, when sounds are mal-observed, to record not what is actually observed, but an erroneous inference, *e.g.* significant words in lieu of nonsense. How much the mind contributes is shown by preliminary experiments, in which students who could record correctly a significant communication through the telephone, the dictaphone, or the air (at twenty-five metres' distance) could not hear definitely enough to identify a half of the consonantal sounds in nonsense syllables through the dictaphone, a third of them over the telephone, or a quarter of them through the air. As a consequence a dictation garbled into nonsense by substitutions of consonantal sounds when heard, *e.g.*, from the dictaphone is converted by the listener, quite unconsciously, into sense, *e.g.* "amb vuth lekrogootheth vu lambwaj vap yuth sporeb im vu wax" is taken down by the listener as "and thus reproduces the language that is stored in the wax." The ear cannot be trusted correctly to report names or phrases when spoken under conditions which, however apparently satisfactory, permit some degree of indistinctness.

That the authorities of the Leland Stanford Junior University should have had some hesitation in accepting the offered endowment will, we think, be readily understood. That Dr. Coover has justified his appointment will, we hope, be agreed. He has presented the results of a series of very careful investigations, organised by a trained worker, which, even if, as in the case of the "card guessing" experiments, they only justify the scepticism of the sceptics, do something at least to clear the field. It may be noted that Prof. Pearson's "Tables for Statisticians and Biometricians" (Cambridge University Press), of the existence of which Dr. Coover seems to be unaware, would have saved him considerable arithmetical work in comparing observed with theoretical distributions.

MEETING OF THE BRITISH MEDICAL ASSOCIATION.

A SPECIAL clinical meeting of the British Medical Association was held in London last week on April 8–11 under the presidency of Sir Clifford Allbutt. The various sections met at the Imperial College of Science, and the attendance of members was large and the meeting a success in every way. The social functions included a reception by the president at the Guildhall, a conversazione at the Royal Society of Medicine, and receptions by the Presidents of the Royal Colleges of Physicians and Surgeons.

In the Section of Medicine Lt.-Col. Mott introduced the subject of war-neuroses. He emphasised the preponderating part played by hysteria in the production of these conditions, and had found that patients with such suggestive symptoms as constant vomiting, constant headache, and recurring fits might all be suffering from functional disease. He condemned the use of the term "shell shock," declaring that many of the men returned as suffering from shell shock would have been more appropriately designated "shell shy." At the same time a proportion of the cases suffer from definite injury to the brain—the cerebro-spinal fluid may contain blood and albumin, the drum of the ear be ruptured, and microscopic hæmorrhages be present in the brain. Sir James Purves Stewart also deprecated the use of the term "shell shock." The frequent occurrence of neuroses in the present war had excited comment, but it was to be noted that in previous wars our men had been trained and seasoned soldiers, and he expressed surprise that the number of cases of neuroses occurring in our armies during the last five years had been relatively so few. The general opinion was that the treatment of war-neuroses was unsatisfactory, and Dr. Yealland and Col. Gordon Holmes decried the use of hypnotism and psycho-analysis.

Influenza was the subject of a joint discussion between the Sections of Medicine and Preventive Medicine. Sir Wilmot Herringham dealt with the clinical aspects of the disease. He emphasised its extreme infectivity, and dwelt on its changed character; so much was the latter the case that he was tempted to ask whether the present disease was influenza at all. Capt. Greenwood, who dealt with the epidemiology of the disease, stated, on the other hand, that we must provisionally conclude that there is no clear-cut formal difference between the outbreaks of 1889–90 and 1918–19.

Major Bowman contributed a paper on the filter-passing germ discovered in collaboration with the late Major G. Gibson and Capt. J. Connor (see NATURE, April 3, p. 90). It had been found impossible to cultivate from the blood of patients Pfeiffer's so-called influenza bacillus. The conclusion was that the primary cause of influenza is some micro-organism other than Pfeiffer's bacillus, probably the filter-passing germ described.

In the Section of Surgery Prof. Bayliss discussed his method of injecting a solution of gum-arabic in cases of wound shock. In this condition the blood-vessels become emptied of blood and more permeable, and hence, if they are to be kept filled, a viscid fluid is necessary, for which purpose the gum solution answers admirably.

Dr. Dale discussed the nature and causation of wound shock. The heart and great vessels are abnormally empty of blood in this condition, and the question arises, Where does the blood go? The answer seems to be that the blood collects and stagnates in the smaller vessels of the skin and other peripheral areas. With regard to the causation of this altered distribution of the blood it has been found

that injections of histamine produce a similar condition; it annuls the "tone" of the capillary vessels, so that they dilate and their walls become abnormally permeable. In cases of considerable injury to muscles (one of the most potent causes of shock) a substance like histamine is generated. Histamine acts more powerfully in animals anæsthetised with ether, and surgeons during the war have noted that patients suffering from shock bear ether badly.

In the Section of Preventive Medicine the dysenteries were considered. Col. Leonard Dudgeon discussed the bacillary form. The dysentery bacillus is scarcely ever present in the blood—in only two cases out of 145 cases examined. The methods of bacteriological examination for the dysentery bacilli were described, and the three methods by which the disease may be spread among a healthy population referred to. These are by "carriers," by infection of water, and by flies. As regards flies, typical dysentery bacilli were isolated from wild flies captured and examined.

Amœbic dysentery was dealt with by Dr. Warrington Yorke. The dysentery amœba is apparently indigenous in England, for it had been found that of 450 civilians in the Liverpool Royal Infirmary who had never been abroad, 1·5 per cent. were infected. Among recruits 5·6, and among lunatics 9·7, per cent. were found to be infected.

Lt.-Col. Dale Logan gave a demonstration on mine-gas poisoning. By the autumn of 1915 mine warfare had made huge strides, and, with the great increase in size of the explosive charges used, more extensive mine systems, and the employment of thousands of men underground, the casualties from mine-gas poisoning assumed serious proportions. The poisoning was entirely due to carbon monoxide gas. The insidious nature of the poisoning and the serious nature of the casualties lent support to rumours that the enemy was employing a new gas and forcing it through into our galleries. The intensity of mine warfare might be gauged by the fact that in 1916 we fired 750, and the enemy 700, mines. At Messines some mines were charged with 90,000 lb. of explosive, and the total charges in all the mines totalled more than 1,000,000 lb. A description was given of the organisation to cope with mine-gas poisoning and of rescue apparatus employed.

Other important discussions and demonstrations were on malaria, injuries of blood-vessels, gunshot wounds of the chest, and bone inflammation and bone repair, details of which will be found in the issues of the *British Medical Journal*.

AGRICULTURAL RESEARCH IN MADRAS.

The 1918 Year-book of the Madras Agricultural Department[1] indicates that the officers of the department are giving attention to a variety of problems of great local importance. No results of wide significance for tropical agriculture are recorded, but a good deal of useful work has been done, which is not without its value beyond the Indian province in which it was carried out.

In "A Note on Grading Cotton" Mr. R. C. Wood gives the results of a grading trial made with cotton grown at the Coimbatore Agricultural College. The crude cotton and the two grades produced in the trial were submitted for valuation to five firms—three spinners and two buyers for export. If 1000 lb. of lint had been graded and sold to each of two of the firms on the basis of these valuations, the reduction in profits as the result of grading would have been 32 and 6 rupees respectively, whilst a similar operation with the three remaining firms would only have added 4, 4, and 17 rupees respectively to the price realised for a like quantity of ungraded cotton. More interest is now being taken in Indian cotton in Great Britain, and the utility of this note to the British reader would have been much enhanced if results of examination of the crude and graded cottons had been given in detail as well as the valuations. In explanation of the disappointing results, the author is only able to suggest that possibly the crop was of poor quality owing to the bad season, and that consequently there was less difference between the crude cotton and the first grade than would normally be the case.

Mr. T. V. R. Ayyar writes on the habits and life-history of *Pempheres affinis*, Faust, a stem weevil, which attacks Cambodia cotton. Treatment of the stems with the usual insecticides has not so far protected the crops from serious damage, but the removal and destruction of the plants first attacked in a plantation have sufficed to check the spread of the pest, and the author suggests that the practice adopted in Uganda of clearing and destroying all cotton plants, after the crop is harvested each year, would probably be a useful preventive measure.

Dr. Harrison, Government Agricultural Chemist, contributes "A Report upon the Extent and Character of the Saline Lands of the Madras Presidency" and "Some Notes on Manures in Southern India." The latter refers to the available sources of supply of lime, gypsum, magnesia, and phosphates, and gives information as to the poonacs (oil-cakes) and fish manures obtainable in the Presidency. A paper by Mr. M. R. R. Sivan on "Phosphatic Nodules of Trichinopoly and their Availability as Manure" is also of interest in this connection. It appears that since 1892 much correspondence and several negotiations regarding concessions to work this area for phosphates have taken place, but so far only small quantities have been extracted for local use.

Dr. F. Marsden has a note in the Year-book on "A Hot-water Process for the Extraction of Indigo," but this subject and other matters relating to indigo are more fully dealt with in the same author's "Indigo Manufacture in Madras," which forms No. 74 of the Madras Department of Agriculture Series of Bulletins.[2] Before starting on his tour of inspection of the Madras indigo districts the author had the advantage of visiting with Mr. W. A. Davis, Indigo Research Chemist to the Government of India, some of the chief Indian indigo factories managed by Europeans, and chiefly situated in Behar. In Madras indigo cultivation and manufacture are almost entirely in the hands of natives, though in at least one instance a European firm issues seed to the ryots and provides vats in which the crop can be worked up for dyestuff; a similar arrangement is sometimes adopted on a smaller scale by native merchants. In most cases, however, the ryot sells his crop to a native vat-owner, or hires a vat in which to manufacture the dyestuff. No records are kept as to yields, and Dr. Marsden regards as untrustworthy the rough estimates he was able to get, which are much higher than the yields recorded in Behar. Though indigo as rich in indigotin as that produced in Behar is made in Madras, the quality is, on the whole, poor, and, what is perhaps worse, variable. These defects are due chiefly to carelessness in manufacture, but also in part, at any rate in some areas, to deliberate adulteration with clay and mud.

The work already done by Mr. Davis in India has shown that the cultivation and manufacture of indigo, even in Behar, where the industry is in the control of Europeans and comparatively well organised, presents many problems, which, if solved, might greatly improve its position and prospects. In the case of

[1] (Madras: Superintendent, Government Press, 1918.) Price 1s. 9d.

[2] (Madras: Superintendent, Government Press, 1918.) Price 6d.

the native industry carried on in Madras, Dr. Marsden points out that the difficulties are much more formidable, and he suggests that the first step towards improvement must be the provision of means for the production of indigo of good and uniform quality. One means to this end would be the replacement of small-scale manufacture in native-owned vats by larger-scale production in well-managed factories, the ryot selling his crop to the factory for manufacture into dyestuff. A possible alternative may be the elaboration of a simple process, capable of being used by the ryot, as the result of the researches now being carried on by Mr. Davis, coupled with some system of analytical control of the produce before shipment.

USES OF INVISIBLE LIGHT IN WARFARE.

PROF. R. W. WOOD, of Johns Hopkins University, Baltimore, gave to the Physical Society of London on March 14 a demonstration of the uses of invisible light in warfare. The first device shown was a signalling-lamp, consisting of a 6-volt electric lamp with a small curled-up filament at the focus of a lens of about 3 in. diameter and 12 in. focus. This gave a very narrow beam, only visible in the neighbourhood of the observation post to which the signals were directed. In order to direct the beam in the proper direction, an eyepiece was provided behind the filament. The instrument was thus converted into a telescope, of which the filament served as graticule. When directed so that the image of the observation post was covered by the filament, the lamp, when lit, threw a beam in the proper direction. In many circumstances the narrowness of the beam was sufficient to ensure secrecy; but sometimes it was not desirable to show any light whatever, and filters were employed to cut out the visible spectrum. By day a deep red filter, transmitting only the extreme red rays, was placed in front of the lamp. The light was invisible to an observer unless he was provided with a similar red screen to cut out the daylight, in which case he could see enough to read signals at six miles. By night a screen was used which transmitted only the ultra-violet rays. The observing telescope was provided with a fluorescent screen in its focal plane. The range with this was also about six miles. For naval convoy work lamps are required which radiate in all directions. Invisible lamps for this purpose were also designed. In these the radiator was a vertical Cooper-Hewitt mercury arc, surrounded by a chimney of the ultra-violet glass. This glass only transmits one of the mercury lines, viz. $\lambda=3660$ Å.U., which is quite beyond the visible spectrum. Nevertheless, the lamp is visible at close quarters, appearing of a violet colour, due to fluorescence of the retina. The lens of the eye is also fluorescent. This gives rise to an apparent haze, known as the "lavender fog," which appears to fill the whole field of view. Natural teeth also fluoresce quite brilliantly, but false teeth appear black.

Reverting to the use of the lamps at sea, they are picked up by means of a receiver consisting of a condensing lens in the focal plane of which is a barium-platino-cyanide screen the full diameter of the tube. An eyepiece is mounted on a metal strip across the end of the tube. When the fluorescent spot has once been found somewhere on the screen, it is readily brought to the central part and observed with the eyepiece. The range is about four miles, and the arrangement has proved invaluable for keeping the ships of a convoy together in their proper relative positions by night.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—A course of eight lectures on "The Physiology of Muscular Exercise" will be given in the Physiological Department, St. Bartholomew's Hospital Medical School, West Smithfield, E.C.1, by Prof. F. A. Bainbridge on Wednesdays at 4.30 p.m., beginning on April 30. The course is intended for advanced students of the University and others interested in the subject. Admission is free, without ticket.

WE learn from *Science* that by the will of the late Mr. Morton F. Plant the Connecticut College for Women receives a bequest of 50,000*l*.

SIR ARTHUR NEWSHOLME has been offered the chair of public health at Johns Hopkins University, Baltimore, and it is understood that he will accept the offer for a year at least.

THE sixth election to Beit fellowships for scientific research will take place on or about July 15. Not more than three fellowships, of the value of 175*l*. per annum, will be awarded. Applications must be received on or before May 31. Forms of application and all information may be obtained, by letter only, addressed to the Rector, Imperial College, South Kensington, London S.W.7.

BY the will of the late Mr. Charles Kerr Marr, the residue of his property, amounting apparently to more than 200,000*l*., is left in trust for educational purposes, defined as follows:—"For granting prizes or rewards to persons who are or have been *bona-fide* residents in the borough of Troon, and who are or have been scholars in some public or elementary school: in or towards building or maintenance of any public school, elementary or otherwise, in Troon; in or towards the maintenance of exhibitions or scholarships tenable at any institution of education higher than elementary, as the trustees may determine, but no exhibition or scholarship shall be awarded to any person who shall not be or have been a *bona-fide* resident in Troon."

IN the issue for April 5 of the *Cologne Post*, a daily paper published at Cologne by the Army of the Rhine, is an article on the education of A iv. boys. The writer states that the boys of eighteen years of age who have been called to the colours recently have, in the majority of cases, proved to be vastly below the standard of education to be expected of boys of that age, as many as 5 per cent. of them being quite illiterate. He goes on to advocate the institution of a system of vocational education while the boys are with the Army of Occupation that will return these lads to their civil occupations each one with his studies completed and with his "apprenticeship" served. The curriculum and time-table of studies sketched in the article indicate a due appreciation of the difficulties of the problem and the possibility of overcoming them successfully.

THE *Cologne Post* of April 1 publishes an interesting account of the work of the 2nd Army Agricultural College at Bonn. The object of the college is to provide interesting and useful occupation for our troops during the period preceding demobilisation. Courses were commenced in January, 1919, since which time large numbers of soldiers, both officers and other ranks, have received short courses of agricultural instruction. At first the lectures were mainly theoretical, dealing with agricultural chemistry and botany, but this was soon altered, and at the present time the students not only have lectures on practical subjects—farm management, etc.—but are also

able to visit the experimental farms belonging to the University of Bonn, where they see the results of various experiments and actual farm operations. In this way men who are farmers obtain an insight into the scientific principles of their subject, while the novices receive a grounding which will be of value in later years. The students are allowed to use the excellently equipped laboratories of the University, and at weekly meetings students give their agricultural experiences in various parts of the world, and the discussion at these meetings supplies some valuable information.

THE Ministry of Health Bill passed its third reading in the House of Commons on April 9. When before the Standing Committee dealing with the Bill, the measure was, in opposition to the wish of the Government, amended in such a way as to transfer from the Board of Education to the Ministry of Health the responsibility for the medical inspection and treatment of school children. In the House of Commons on April 9, when the Bill returned for further consideration, Dr. Addison proposed to add to it words to the effect that the Minister of Health may make arrangements with the Board of Education respecting the submission and approval of schemes of local education authorities and the payment of grants to these authorities, so far as such schemes and payment relate to or are in respect of medical inspection and treatment; and the powers and duties of the Minister may under any such arrangements be exercised and performed by the Board on his behalf and with his authority under such conditions as he may think fit. After some discussion, and the insertion of words in the amendment confining its scope to medical inspection and treatment, it was agreed to. In other words, it is now possible for the Minister of Health, should he so desire, to delegate to the Board of Education those of his powers which have hitherto been administered by the Board.

IN *School Hygiene* for November last Dr. James Kerr writes on "Congenital or Developmental Aphasia." He points out that although the bibliography on the subject is fairly large, yet little attention has been paid to the theoretical importance and wide bearings of congenital aphasia, when it exists apart from coarse nervous defects. The cases may be conveniently grouped, according to the leading symptom, as graphic and auditory aphasia, of which auditory aphasia, being more fixed by heredity, is less common. Dr. Kerr reviews and criticises the various theories put forward with regard to these cases, and points out that aphasics are sufficiently numerous to warrant more care than they can receive in the ordinary schools. Children who suffer from word-blindness may be highly intelligent in all other respects, and for their best development require special treatment in a children's institute or psychological observational school. Every school population exceeding 100,000 requires some such institute. If the particular brain defect is diagnosed early, many, though not all, are capable of much educational improvement, and the defect so compensated that for practical purposes the individual may be considered normal. If not treated, such children tend to swell the numbers in prisons and asylums.

THE League for the Promotion of Science in Education, formed by the Committee on the Neglect of Science, which arranged a very successful conference at the Linnean Society in 1916, is organising another conference, to be held at the Central Hall, Westminster, S.W., on April 30, at 2.30 p.m. The following resolutions will be submitted to the conference:—(1) That this conference directs attention to the continued neglect of science in the country, and calls upon the Government to make immediately such changes in all administrative Departments as shall ensure therein an adequate representation of scientific men. (2) That this conference anxiously awaits a statement on the part of the Government as to the measures it proposes to take to carry out the recommendations set forth in the report of Sir J. J. Thomson's Committee on Natural Science in the Educational System of Great Britain. (3) That this conference, whilst fully recognising the value of a literary training, is, nevertheless, of the opinion that the present public school and university system fails to produce that activity of mind and breadth of knowledge which are essential in a liberal education and necessary for dealing satisfactorily with modern problems. It therefore calls for a closer co-operation between education and industry, and for this purpose emphasises the importance of appointing to head-masterships men of high scientific attainments. No tickets of admission are required, and the Council of the League hopes that there will be a large assembly at the conference to support these resolutions, and thus assist in securing action upon them.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, April 3.—Sir David Prain, president, in the chair.—W. B. **Brierley**: An albino mutant of *Botrytis cinerea*, Pers. The fungus *Botrytis cinerea* possesses characteristic black sclerotia, the colouring matter being deposited in the walls of the outer two or three layers of cells. Among the black sclerotia in a pedigree culture a single colourless sclerotium was formed, and on isolation this gave rise to a strain characterised by colourless sclerotia. Morphologically and physiologically the parent and mutant strains are identical, and the only difference is the lack of colouring matter in the latter. A generation of the fungus may be obtained in three days, and the two strains tested over very many generations under the most diverse conditions have proved absolutely constant. As the colourless form arose in a "single-spore" culture, it cannot represent a strain selected out from an original population; and as *Botrytis cinerea* is asexual, the possibility of the new form being a segregant from a heterozygous parent is eliminated. Furthermore, the occurrence of colourless sclerotia in this fungus has heretofore been unknown either in Nature or when the fungus was grown on culture media. There would, therefore, seem no reason to doubt that the colourless form described is an instance of true mutation in the fungus *Botrytis cinerea*.—Dr. J. D. F. **Gilchrist**: The post-puerulus stage of *Jasus lalandii* (Milne-Edw.), Ortmann. This paper carried on the investigation already published in the Journal of the Linnean Society, Zoology (vol. xxxiii., 1916, pp. 101–25, pls. 12–17, with 12 text-figures), as "Larval and Post-Larval Stages of *Jasus lalandii*," etc. The New Zealand crayfish is now considered to be identical with this Cape species, and found to be of wide distribution. The stage here described is that immediately following the "puerulus" stage; it represents the transition to the adult form. The specimens were obtained by trawling in Table Bay and taken to the marine laboratory at St. James, near Cape Town, where the observations now recorded were made. The author gives minute descriptions, illustrated by drawings similar to those in his previous paper.—Dr. H. H. **Mann**: Variation in flowers of *Jasminum malabaricum*, Wight. In the forests of the Western Ghats of Bombay, during the month of April, the jungle is covered with flowers of this fragrant and attractive climber. Between April 13 and 20, 1916,

the author had examined 2789 flowers for the corolla, and found from five lobes in 0·33 per cent. to a maximum of eight lobes in 40 per cent., declining to a percentage of 0·04 for those with twelve lobes. Similarly, the teeth of the calyx were examined in 3560 flowers at the same time, and showed with four teeth 2·56 per cent., with five and six lobes the maximum with respective percentages of 46·26 and 47·81, the last being of eight teeth with 0·22 per cent.

Aristotelian Society, April 7.—Prof. Wildon Carr in the chair.—A. F. **Shand**: Emotion and value. Intrinsic value, whether in external things or in the constituents of the mind, is not a simple, statical quality that can be found in some things, but about which nothing further can be said. It is essentially dynamical. It presupposes always something on which it can act, with which it has affinity, and the power of acting on this thing in certain ways. Such value cannot, therefore, be wholly contained in or confined to the thing which possesses it; for a condition of intrinsic value is the power of propagating the same kind of value in the other thing with which it has affinity. But this power, though a part and condition of this value, does not sum it up. For things would not have power to produce excellent effects unless there were something excellent in their own nature. Fear, anger, and hate have one kind of effect; joy, admiration, and love have an opposite kind. The power of each depends on its own nature. The power which is a condition of intrinsic value is therefore also conditioned by it.

Zoological Society, April 8.—Dr. S. F. Harmer, vice-president, in the chair.—Dr. F. E. **Beddard**: Three fœtal sperm whales. Attention was directed to the smallest fœtus exhibited, which measured 4½ in. in length.—L. T. **Hogben**: The progressive reduction of the jugal in the Mammalia.—G. A. **Boulenger**: Two new lizards and a new frog from the Andes of Colombia.—R. I. **Pocock**: Structural characters by which the genera of Felidæ may be distinguished from each other. Special attention was directed to the formation of the feet in the cheetah (Acinonyx), to the modifications of the hyoidean apparatus in the lions, tigers, leopards, and jaguars (Panthera), and to the position of the partition in the auditory bulla in other genera.

BOOKS RECEIVED.

Sands: Considered Geologically and Industrially under War Conditions. By Prof. P. G. H. Boswell. Pp. 38. (Liverpool: At the University Press.) 1*s*. net.

Organic Chemistry; or, Chemistry of the Carbon Compounds. By V. von Richter. Edited by Profs. R. Anschütz and G. Schroeter. Vol. i.: Chemistry of the Aliphatic Series. Translated and revised by Dr. P. E. Spielman. Second (revised) edition. Pp. xvi+719. (London: Kegan Paul and Co., Ltd.) 21*s*. net.

Food (War) Committee, Royal Society. Report on the Composition of Potatoes Grown in the United Kingdom. Pp. 31. (London: Harrison and Sons.) 2*s*.

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part xviii. (London: W. Wesley and Son.)

A Summary of My Theory of the Sun. By Dr. A. Brester. Pp. 62. (The Hague: W. P. Stockum and Son.)

Carburettors, Vaporisers, and Distributing Valves Used in Internal-Combustion Engines. By E. Butler. Second edition. Pp. viii+288. (London: C. Griffin and Co., Ltd.) 12*s*. 6*d*. net.

The Mica Miner's and Prospector's Guide. By A. A. C. Dickson. Pp. viii+50. (London: E. and F. N. Spon, Ltd.) 4*s*. 6*d*. net.

Birds Beneficial to Agriculture. By F. W. Frohawk. Pp. vi+47+22 plates. Economic Series, No. 9, British Museum (Natural History). (London: British Museum, Natural History.) 2*s*.

Report on Cetacea Stranded on the British Coasts during 1918. By Dr. S. F. Harmer. Pp. 24. (London: British Museum, Natural History.) 3*s*. 6*d*.

T.N.T. Trinitrotoluenes and Mono- and Dinitrotoluenes: Their Manufacture and Properties. By G. C. Smith. Pp. vii+133. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

The Life of Matter: An Inquiry and Adventure. Edited by A. Turnbull. Pp. xviii+324+iv plates. (London: Williams and Norgate.) 7*s*. 6*d*. net.

Calcul des Valeurs Absolues. By D. Riabouchinsky. Pp. 113. (Copenhague.)

DIARY OF SOCIETIES.

THURSDAY, APRIL 24.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Major A. C. Fuller: The Fullerphone, and its Application to Military and Civil Telegraphy.

TUESDAY, APRIL 29.

ZOOLOGICAL SOCIETY, at 5.30.—Dr. W. T. Calman: Marine Boring Animals.—Noel Tayler: A Unique Case of Asymmetrical Duplicity in the Chick.—Geo. Jennison: A Chimpanzee in the Open Air in England.

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THURSDAY, APRIL 24, 1919.

THE NATION'S DEBT TO SCIENCE.

THE noble record of the universities and schools of England in the recent war may one day come to be written. It is doubtful if anyone has realised as yet how great will be its full extent. There is one page in particular which will contain more than is grasped even by those who have had the best opportunities of doing so. It will tell of the special work of the men who have been trained in the scientific and technical laboratories.

The war has called for every ounce of scientific knowledge and effort. It could not be otherwise when great nations have been straining their utmost, and when the advantage has so often gone with the best use of every help that modern knowledge could give. The scientific battle has been fought by the laboratory men.

The mastery of the air, for example, has depended on the skill and courage of the pilot, but also, very vitally, on the perfection of his machine. The latter, in its turn, has depended on the knowledge gained with infinite care by those who have tested out each detail of design. The engine itself with its many complicated parts, the form of the struts and planes, the covering fabric and the varnish applied to it, the recording instruments, the photographic gear, the signalling apparatus, the machine-guns, the bomb-dropping arrangements, each of these has been the subject of experimental research requiring the highest technical skill. Each was improved beyond all belief during the war: by how much labour and devotion only those intimately connected with the work can tell. Some of our finest men of science lost their lives in this service. Yet on all this improvement the success of air warfare depended, for it was the last additional strength or trustworthiness, quickness of manœuvre, or power of flight that gave the pilot confidence and superiority; and the staff who carried out this work, whether at Government experimental stations or at the National Physical Laboratory, or elsewhere, were for the most part drawn from the laboratories of the universities and technical schools.

So, too, with the brigade of chemists, who did so much in the war. Professors and lecturers became senior officers in the brigade; junior officers were drawn from the students. They fought the German gas, devising the protective masks and instructing the Army in their use; they worked out the processes for manufacturing gases on a large scale for the use of our own armies. The huge industry of the manufacture of explosives required the solution of chemical problems, which they accomplished, and so saved the nation vast sums of money, and made it possible to supply the Army with all that it wanted. They produced the smoke-screens, and the special bullets that brought down Zeppelins and observation balloons. They solved innumerable problems involved in the great business of supplies; they were constantly the advisers of the Munitions Department, of the health authorities, of the Intelligence, and in a thousand-and-one ways they were indispensable to the progress of the war. The nation has indeed cause to be grateful to its chemical laboratories.

A body of keen young physicists, drawn from various universities of the Empire, developed the methods of sound-ranging until it became possible to locate with extraordinary accuracy the positions of enemy guns, even during the continuous roar of the Western front; they were responsible for a great part of the locations on which artillery work depended. The same methods applied to under-water work by the Admiralty experimental stations made it possible to locate with accuracy explosions occurring hundreds of miles from the shore, and incidentally have furnished the hydrographers with a means of shortening enormously the work of charting the seas. Much of the work of the Admiralty stations, especially that which related to anti-submarine defence, may not, of course, be discussed in public. It can only be noted that here also the universities and technical schools were largely represented on the staffs.

It is impossible even to enumerate the various branches of scientific service. There was the highly efficient and most important gauge work of the National Physical Laboratory; the work of the men who listened for and located the underground operations of the enemy miners; the wide range of most important optical work, from the submarine periscope to the aeroplane camera; the research work on wireless telegraphy, which was so immensely advanced during the war; the meteorological work which was of such great service to the air forces; the geological work of the front; the bacteriology; and so forth. It is impossible to give the barest recital of all the scientific work involved in the immense problems of the medical service. In every section of the operations by land, by sea, and in the air urgent experimental work was carried on, results were obtained which were of the highest importance, and the first-class scientific work which was required was carried out mainly by the men already mentioned, the science teachers and students of the universities and technical institutions.

The war may now be over, and these special occasions for service may no longer exist. But in the long new struggle before us the need for scientific training and method is as great as ever. Our capital is gone. We must pay our debts and earn our living, and, besides, we must amend the pre-war conditions of our workers' lives. It cannot be done except by making every use of the knowledge we have already, and by labouring to add to it: that is to say, by following scientific methods. The services of the laboratory-trained men will still be indispensable. That there is a general understanding of the position is shown by the crowding of new students into the universities, and the demand for instruction in science.

But where are the teachers and the apparatus for teaching? Even before the war the salaries, especially of the junior staff, were poor and the positions few. Many of the former teachers will not come back, for some have been lost in the war, and others are being attracted by the better prospects of research laboratories and commercial work. The universities have no funds wherewith to meet the proper increases of salaries or any increase of staff, for their grants remain unchanged, all expenses have increased, but they may not raise their fees. The number of students is growing rapidly, and, as things are, increase in numbers generally means an increase in expenditure. Most of the universities are really unable to carry on without increased aid from the State.

The sowing of the seed is the last thing that may be neglected if there is to be a harvest, and all our experience, thrown into strong relief by the war, shows that the harvest of the successful development of the work of this country, work which is to pay our debts and bring comfort to our peoples, will follow only on the application of scientific method and research, which is the seed sown in universities and technical schools.

FOUNDATIONS OF ELECTRICAL THEORY.

The Theory of Electricity. By G. H. Livens. Pp. vi+717. (Cambridge: At the University Press, 1918.) Price 30*s.* net.

ELECTRICAL theory, the most rapidly growing part of physics, has now reached such dimensions that no author can hope to produce a text-book which will deal effectively with its many aspects. A series of such books is necessary which shall take different points of view and lay especial emphasis in certain broad directions. We already have several, and notably the works of Jeans and Richardson, which are both comparatively recent. But lacunæ remain, and one of these the present author has set out to fill. We may say at the outset that he has filled it with considerable success, for the work now before us in no way constitutes a reduplication of any important part of an existing treatise. It is, moreover, one which can be recommended without reserve to a student who is anxious to obtain a clear picture of the fundamental principles underlying certain important, and often rather neglected, aspects of electromagnetic theory.

This is said advisedly, for the feature of the book which makes the strongest appeal to the reader is probably the excellent account of that much-discussed and rather chaotic subject, the energy, stress distribution, and general mechanical relations of polarised media. Matters of this kind are usually presented very imperfectly to the student, in spite of the classical foundation which exists in papers by Larmor, and the author has done good service in directing attention to them by their incorporation, in a consistent and very complete form, within the compass of a treatise of this size. If any other section of the work were selected as deserving of special mention, it should probably be that devoted to conduction of electricity by metals, with some of the small, though fundamental, phenomena which accompany it. The author has himself contributed a great deal of work to the subjects described in these sections, and is especially qualified to give an effective account of them.

The preface describes the work as largely the outcome of a course of lectures delivered ten years ago by Sir Joseph Larmor. We may express regret that such a fine compliment is so rarely paid to those who lecture by members of their audience. Although dealing with a mathematical subject, the mathematical side is kept under control by the author, who does not expound it beyond the point necessary for a real comprehension of the principles involved, and an insight into the manner in which they must be worked out in detail. References to the more complete or elaborate investigations are provided as footnotes, and, though by no means exhaustive, these are sufficiently numerous to direct the reading of those who wish to pursue special sections of the subject.

There are two main divisions of electrical theory at the present day, both extensive. In the first place, we have the original framework of Faraday and Maxwell, developed for systems in motion by Larmor, and just afterwards, with more generality, by Lorentz. Superposed on this is the more speculative side, including the principle of relativity, theories of atomic structure, photo-electricity, and other branches, together, in fact, with all the phenomena for which the quantum theory has been invoked. We call this section speculative only by comparison, in that its mathematical and logical foundations and inter-connections are of a lower order of security. It has been well developed in existing treatises, and is not seriously touched upon in the present work. The need for a comprehensive treatise on the older form of theory, satisfactory from the point of view of mathematical and physical consistency, if not always capable of including certain phenomena within its scope, has always been felt, and

this work supplies the need in a satisfactory manner. We have mentioned the principle of relativity, and in this special case it would obviously have been part of the author's plan to include some of the more striking developments of this principle in connection with gravitation, which are all very recent, and were very inaccessible in this country until the publication of Prof. Eddington's report by the Physical Society after the present work had been printed. The author himself indicates a wish to include some account of this subject, if a future edition should be called for. We are disposed to concur in his main thesis that the essential introduction to the student should be in terms of the older established theory on which the newer and more variable structure has been built—a thesis not directly expressed, but everywhere implied.

Some of the more analytical processes are dealt with in a special introduction, apart from the rest of the book. This contains such subjects as Green's and Stokes' theorems—especially in their application to moving circuits—differentiation of potential integrals, Kirchhoff's theorem—too frequently neglected—and, in particular, an elementary account of the properties of vectors and their nomenclature. This introduction is brief, but should be a great assistance to the student in preventing later diversions of his attention from the main theme. There is considerable difference of opinion as to how far the use of vector notation is in fact an assistance to economy of thought in all readers. There appears to be a personal element or predisposition in the matter, but, fortunately, the question does not arise here, as a too exclusive use of vectors is not adopted, and the style of the book is such that it should prove easy to any reader qualified to make a serious study of the subject.

No error of statement, or remark capable of a wrong interpretation, has been detected, and evidently special care has been bestowed on clearness of statement in sections where, from the nature of the subject, such clearness is not easily attained. There are apparently very few misprints, and the work, which is produced by the Cambridge University Press in the form now familiar by many recent examples, is in keeping with the traditions of the Press. J. W. N.

THE ADVANCEMENT OF EDUCATION.

(1) *The Spiritual Foundations of Reconstruction. A Plea for New Educational Methods*. By Dr. F. H. Hayward and Arnold Freeman. Pp. lxi + 223. (London: P. S. King and Son, Ltd., 1919.) Price 10*s*. 6*d*. net.

(2) *The Great War Brings it Home. The Natural Reconstruction of an Unnatural Existence*. By John Hargrave ("White Fox"). Pp. xvi + 367. (London: Constable and Co., Ltd., 1919.) Price 10*s*. 6*d*. net.

(1) We welcome the freshening breeze in the educational proposals brought forward by Dr. Hayward and Mr. Freeman. "The function of the schools is to educate the community into a knowledge of Truth, a sense of Beauty, and a love of Goodness; that function they have failed to discharge." According to the authors, the failure is largely due to laughably "unpsychological" methods. A revolution is necessary. "Arithmetic, handicraft, language, and kindred efficiency subjects may be *taught*—taught to Jack and Jill by Bob and Dick." But "the class teaching of the Bible, literature, music, history, and certain other subjects should be largely abolished in favour of a liturgical, ceremonial, or celebrational treatment." There should be days *devoted* to great personalities (St. Paul, Alfred the Great, Joan of Arc, St. Francis, George Washington) or great ideas (the League of Nations, France, agriculture, science, freedom). The humdrum duties of life should be expounded in lessons in which the main emphasis is on the reason, matters of personal hygiene, for instance, being brought home by scientific argument. In the liturgy reason would be subordinate to feeling—to "admiration, hope, and love." Representatives of all sects, parties, professions, movements, etc., as well as teachers, should be urged to give addresses to the whole school at times set apart for this in the liturgical arrangements. On such occasions, so far as accommodation could be provided, parents and "the public" should be invited.

The authors expound these proposals with conviction, and we are wholly convinced. If even a little could be done in the directions indicated (and in some cases illustrated in concrete detail) there would be education of the heart and conscience, an enrichment of the memory, a widening of horizons, and a vitalising of the whole school life. The authors have taken the trouble to anticipate and answer thirty objections, and this makes good reading.

In addition to the proposals we have referred to, Dr. Hayward and Mr. Freeman advocate the preparation and utilisation of charts showing the geological ages, the course of human history, the solar and stellar systems, the history of science, of art, and of great ideas. This is an educational method used here and there, but, on the whole, undreamt of and long overdue. The charts can be made vivid if brains are put into the making of them, and where colours are used it pays to get an artist to choose them. We should personally have liked more "Nature" days than the authors seem to think of, but we are heart and soul with their recommendations.

(2) Mr. Hargrave's book was written before the war, but he has been able to strengthen it since his return to civil life. For his convictions have been deepened by experience, and the urgency of his recommendations seems to him greater than ever. He has been impressed with the unnaturalness of man's life in ordinary civilised conditions. Instead of evolving a sane, healthy, and hardy race, the trend of civilisation seems to be in the opposite direction. The type that is being increasingly produced is not only

unnatural; it is not even fitted for civilised conditions. Too many lives are lacking in health, happiness, and real efficiency. What Mr. Hargrave pleads for is more outdoor education and a renewed enthusiasm for vigour. Modern educational methods have tried to dispense with the natural individual recapitulation of racial history, and the result has been a dismal failure. Mr. Hargrave pleads for real sojourning with wild Nature, camp education, tribal training for boys, hardihood camps for young men, adolescence initiations, and open-air meditation. Perhaps there is a tendency to exaggerate the importance of tribal training; perhaps the author is not quite sound in his view of human instincts and their origin; perhaps it is not very fortunate to speak of "that process of natural selection known as Evolution"; perhaps the practical difficulties in the way of methodical open-air education for large numbers are under-rated; but there is no doubt that the book is full of the true eugenist enthusiasm and of valuable suggestions for making much of outdoor life and Nature's school. It expresses the boy scout's idea raised to a higher power.

Two general remarks we venture to make in reference to both books: (*a*) Half a loaf is better than no bread, and if a teacher cannot go all the way either with the open-air education of Mr. Hargrave or with the "spiritualised" education of Dr. Hayward and Mr. Freeman he may go some way; and (*b*) the relative failure of past educational endeavours is not wholly due to imperfect methods; it is largely due to imperfect material. Who is bold enough to set limits to what improved nurture can do? but a soberminded vision cannot ignore the sad limitations of inborn nature. Yet one remembers a famous answer given to Nicodemus. J. A. T.

OUR BOOKSHELF.

The Cultivation of Osiers and Willows. By W. P. Ellmore. Edited, with Introduction, by Thomas Okey. Pp. x+96. (London: J. M. Dent and Sons, Ltd., 1919.) Price 4*s*.

THE growth of osiers, as willows used for basket-making are popularly called, was a declining industry before the war, owing to foreign competition. From Germany, Holland, and Belgium we received, year after year, not only increasing quantities of osiers, but also large importations of baskets and basket-ware, as well as huge consignments of hoops for herring barrels, which are the product of a year or two's extra growth of the common species. Alarmed at the decline of an important local industry like basket-making, the Board of Agriculture, in order to encourage the extension of the area under willow cultivation, published a series of articles by Mr. W. Paulgrave Ellmore on the subject in its Journal for 1911 and 1912, which were reprinted in 1913 as a booklet—"Board of Agriculture, Miscellaneous Publications, No. 18." The present handbook is an enlargement of this, and is well worthy of the attention of farmers and landowners who have land suitable for the growth of willows. Osiers, it is necessary to point out, require good land in order to succeed, such as low-lying alluvial tracts beside rivers and streams, and they fail miserably on wet, undrained, swampy, or peaty soils.

Mr. Ellmore gives sound information on the cultivation and harvesting of the osiers and on the preparation of the rods for the market. A chapter on the numerous varieties which are used gives no botanical details, but is of interest in pointing out the special uses, adaptations to soils, etc., of these puzzling forms, which are generally supposed to have arisen through hybridisation of the four or five species under which they are classed. Another chapter deals with insect pests and methods of control. A final chapter treats of the three willows which are grown for their timber.

Standard Tables and Equations in Radio-telegraphy. By Bertram Hoyle. Pp. xiv+159. (London: The Wireless Press, Ltd., 1919.) Price 9*s*. net.

IN his preface the author claims that no such complete book of tables and equations exists for the use of radio engineers. It is difficult, however, to see the guiding principle he has adopted in selecting his formulæ and tables. Several of the tables are antiquated, if not actually obsolete, and some of the information might well be given in an elementary text-book of arithmetic.

The author begins by giving the latest formulæ for calculating the capacity and inductance of various geometrical-shaped objects with high accuracy. Judging from this and other books on the subject, one would infer that radiotelegraphists spent most of their time in making calculations by the laborious formulæ so familiar to readers of the mathematical bulletins of the Bureau of Standards. Yet it is of importance to be able to calculate the capacity between spherical conductors or between parallel wires, and so we wonder why no formulæ are given for them in this book.

We find a table of haversines, but, as the haversine is not defined and we have forgotten what it means, it is no great help. We are given tables of all kinds of wire gauges—the Birmingham, the Brown and Sharpe, Stubs's steel wire, Whitworth's, piano-wire gauge, etc. For practical purposes these gauges are obsolete. Electricians and cable-makers nowadays talk about a 0·0100 wire—*i.e.* a wire the diameter of which is the hundredth of an inch. They do not talk about a No. 33 wire S.W.G. It is astonishing how long the gauge system, which was hopelessly unscientific, lasted in this country. We hope that when the cable-makers' new standards are published next summer the wire gauges will soon be forgotten.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ionisation and Radiation.

WHEN X-rays pass through a gas, only a very small fraction of the molecules—in favourable circumstances, one in a billion—is ionised by them, and the extent of this ionisation is unaffected by temperature. Writers on radiation seem to have difficulty in reconciling this with the wave theory of light. I venture to suggest that the difficulty arises from an imperfect comprehension of what the wave theory requires.

The inverse square law of intensity ought not to hold for very small spaces and very small times. The uniform spherical wave spreading out from a point source is a mathematical fiction. What we really have is a very great number of spherical wavelets, each diverging from a different electron, criss-crossing in various directions, and consequently interfering with one another. For example, suppose that there are n electrons in the source, all close together, and that the intensity of radiation is required at a point P at a distance r, great in comparison with the linear dimensions of the source, and so sensibly the same for all the electrons. Let the intensity at P due to a single electron be I/r^2. Then the resultant intensity may be anything from 0 to n^2I/r^2, according to the number of wavelets coincident in phase at P, the lower values predominating. If the phases of all the different waves are absolutely at random, the problem reduces to a celebrated one solved by Lord Rayleigh, and the chance of a particular intensity J is

$$\frac{r^2}{In}e^{-Jr^2/In}dJ.$$

It follows simply from the laws of chance that the intensity must be exceptionally great at some points; the very existence of an average value implies this. If one in a billion molecules is ionised, the ionising intensity works out at 27·6 times the average intensity at P. If there is any regularity of structure in the source, Lord Rayleigh's expression may not do justice to the higher intensities.

Thus it is not necessary to assume that X-rays consist of neutral atoms, or that the ether has a fibrous structure, or to take refuge in the nebulous phraseology of the quantum theory; the explanation follows naturally from the principle of interference as expounded by Fresnel.

R. A. HOUSTOUN.

University, Glasgow, April 11.

The Whiteness of the Daylight Moon.

WATER holding in suspension fine particles of mastic scatters a blue light. Place behind the containing vessel a yellow surface. (1) If this is bright, its light, transmitted through the vessel, prevails, and we see the yellow. (2) Subdue the illumination of the yellow surface sufficiently, and the water appears white, the yellow and the blue just compensating each other. (3) Subdue the yellow still more, and the scattered blue again becomes evident. If in case (2) we use a Nicol, then, for minimum transmission, the white changes to yellow; but, for maximum transmission, to blue, because the scattered blue light is largely polarised.

Now Nature supplies us on a large scale with an admirable example of similar phenomena. Suppose the moon to be at her first quarter in daylight. The moon's reflected light is yellowish, that of the sky is blue, due to scattering, and is considerably polarised 90° from the sun. Between us and the moon there is sky. The whiteness of the daylight moon is, in my opinion, an example of case (2) above, and at the first quarter I find that she behaves to a Nicol in the way already described. I have not previously met with any account of this grand natural example of the fact that a mixture of blue and yellow lights produces white.

C. T. WHITMELL.

Invermay, Hyde Park, Leeds, April 15.

REFRACTOMETERS.

AMONGST the physical properties which are characteristic of a substance, the refractive index is one of the most important. From a theoretical point of view, the fact that refractivity is mainly an additive quantity—the molecular refractivity being approximately the sum of the atomic refractivities—is highly significant. From a practical point of view, the ease and accuracy with which refractive indices can be determined by modern methods are of great service, both to the physicist and to the chemist, in the examination of the materials with which they have to deal. Whether for purely scientific or for technical purposes, such a determination affords a rapid method of finding the concentration of solutions and the purity of oils, fats, waxes, and foodstuffs. New applications are continually arising in a variety of industries dealing with drugs, sugars, paints, varnishes, glue, gelatine, and other colloids. The physicist finds the method of service in the identification of optical glasses or in the study of singly or doubly refracting crystals.

A ray of light passing from an optically dense to a rarer medium is bent away from the normal to the surface, and when the angle of incidence assumes a certain definite value the emergent ray just grazes the common surface. For angles of incidence greater than this *critical angle*, the light is no longer refracted, but undergoes total internal reflection. The refractive index, in passing from the rare to the dense medium, is the reciprocal of the sine of the critical angle. It is interesting to learn that the first to apply this property as a practical method for finding the refractive index was Wollaston, who constructed and described in the *Philosophical Transactions* in 1802 a critical-angle refractometer, using a right-angled prism as adopted later by Pulfrich.

In 1874 E. Abbe, of Jena, described the refractometer which, as constructed by the firm of Zeiss, has been familiar for the past forty years. In this instrument the substance to be examined is placed on the hypotenuse face of a right-angled prism, having one of its angles accurately 60°. When the substance is a solid, optical contact with the prism is made by means of a liquid of higher refractive index than the solid; when a liquid is to be examined, one or two drops are enclosed as a film between two similar prisms. It has been pointed out previously in these columns that *both* these prisms should be made of glass of high refractive index, in order to secure sufficient illu-

mination (NATURE, June 21, 1917). The prism system is rotated by means of the index arm until a dark shadow comes into the field of view of the telescope, and the edge of the shadow is adjusted exactly on the cross-lines. The refractive index for sodium light is then read directly on the scale of the instrument, the accuracy of reading being one or two units in the fourth decimal place. When white light is employed, the dispersion of the emergent light is neutralised by means of an Abbe compensator. It is satisfactory to find that British firms have produced instruments which are undoubtedly superior to the German pattern, and that they have been able to supply the demand in various Government Departments that has arisen during the war. The firm of Adam Hilger now produces standardised instruments in which not only the mechanical, but also the optical, parts are interchangeable (Fig. 1). Tables of refractive

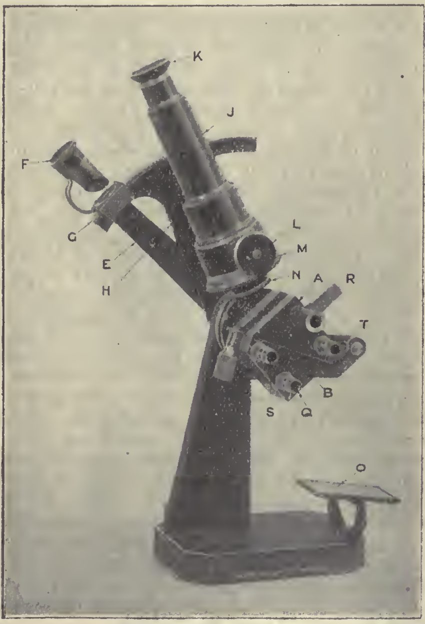

FIG. 1.—Abbe Refractometer (Adam Hilger, Ltd.). A, Upper prism jacket; B, lower prism jacket; E, reader arm; F, reader; G, scale; H, scale arm; J, telescope; K, telescope eyepiece; L, milled head for Abbe compensator; M, scale for Abbe compensator; N, adjusting ring for lower D.V. prism; O, mirror; Q, S, and T, prism jacket nozzles; R, nozzle with thermometer chamber.

indices of industrial substances are in course of publication, and should prove of great value.

Messrs. Bellingham and Stanley have produced an instrument of distinctive design, embodying several improvements on the German type (Fig. 2). The prism-box is now designed to open away from the operator, which makes it much easier to examine plastic or solid substances. It is no longer necessary to reverse the instrument, and full use may be made of the illuminating mirror. At the same time, the change permits of greater rigidity of construction. The reader arm is provided with a slow motion by a simple friction device, and the halves of the prism-box may be separated automatically by a small movement of the clamping head. The lower half is so constructed that it can be removed quickly without tools.

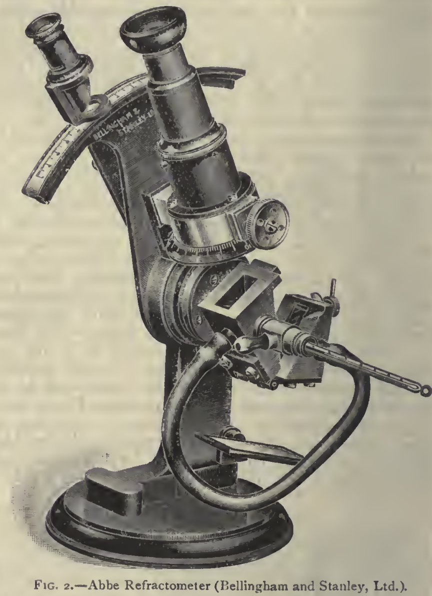

FIG. 2.—Abbe Refractometer (Bellingham and Stanley, Ltd.).

When measurements of a higher degree of accuracy are desired than is possible with the Abbe type of instrument, the dipping refractometer (Fig. 3) may be employed, but with a single fixed prism readings can be obtained only over a limited range of refractive index. The prism of the instrument dips into the liquid, which is placed in a small containing vessel, and the refractive index is determined by the position of the border-line of total reflection seen in the eyepiece. The eyepiece carries a photographic scale, and a micrometer screw adjustment is provided whereby the position of the border-line with respect to the scale division may be measured directly. A table is supplied giving the refractive index in terms of the scale reading. In the German type of instrument the prism is cemented into its holder, and can be used only for solutions of refractive indices between 1·325 and 1·367. In hot and moist climates the solution frequently creeps up through the cement on to the upper face of the prism. When this occurs, or when the prism is damaged, it is necessary to return the entire instrument to the makers. Messrs. Bellingham and Stanley have improved the design of the instrument, and

arranged for the prism to be capable of easy removal for cleaning purposes or for renewal. An additional advantage of this method of construction is that a series of prisms may be employed, giving further ranges of refractive indices

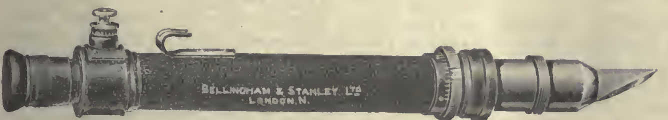

FIG. 3.—Dipping Refractometer (Bellingham and Stanley, Ltd.).

up to 1·55, with an accuracy of three or four units in the fifth decimal place.

For measurements of still higher accuracy, the Pulfrich refractometer is available (Fig. 4). In ordinary use this instrument will give results four or five times as accurate as those obtained by

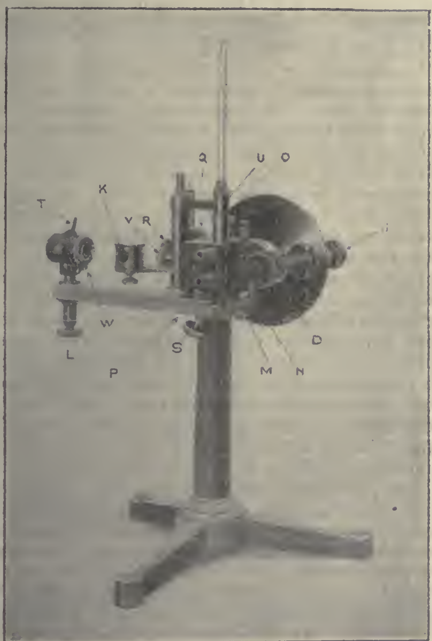

FIG. 4.—Pulfrich Refractometer (Adam Hilger, Ltd.). D, Telescope object-glass and prism dust cover; J, telescope helical focussing E.P.; K, prism for use with sodium burner; L, condenser height-adjusting milled head; M, bottom water jacket with Pulfrich prism; N, top water jacket; O, thermometer case; P, circle slow motion (position only indicated); Q, slow motion vernier (position only indicated); R, slow motion arm clamp milled head; S, clamp screw for bottom water jacket; T, light screen; U, thermometer adapter case; V, thermometer case operating milled head; W, clamp for vacuum tube holder.

means of the Abbe refractometer. Mr. J. Guild, of the National Physical Laboratory, claims that, with proper care in design and use, the Pulfrich refractometer will give results accurate to the fifth decimal place, not only in the dispersion, but also in the absolute index. In this instrument the substance to be examined is placed on top of the horizontal surface of a block of glass of known refractive index. Rays entering the substance from one side can pass out from the opposite vertical surface of the Pulfrich prism only when they enter above the horizontal boundary surface. A sharp line representing the rays which have just been able to enter the prism is observed in the telescope. The angle of emergence is measured by rotation of the telescope, which is attached to a divided circle. Messrs. Hilger have designed a new instrument in which all screw-heads are brought within reach of the observer's right hand. Direct readings on the vernier of the divided circle are accurate to one minute, and on the divided drum of the slow motion to six seconds. In accurate measurements the questions of temperature control and of the source of light employed must receive careful consideration.

THE ATLANTIC FLIGHT.

THE first attempt to cross the Atlantic by aeroplane will go down to posterity as one of the milestones in the progress of aviation, and there seems little reason to doubt that this feat will soon be accomplished. The two main factors affecting the result are the trustworthiness of the engine and the state of the weather. The best engines of to-day are capable of running for periods considerably longer than that required for the crossing, and, although it is impossible to say that a given engine will accomplish a twenty-hour run without mishap, the chance of failure due to engine breakdown is by no means exceptionally great. On the other hand, the weather is extremely difficult to forecast, and very little information is obtainable as to the conditions prevailing at a height of 10,000 ft., even though the surface conditions are fairly well known. Every possible provision will be made for the safety of the aviators in the case of a forced descent at sea, but the element of risk is naturally a very serious one, and we can but admire the men who are so ready to face it.

Mr. Hawker, on his Sopwith machine, is carrying a collapsible boat, attached to the upper side of the fuselage, containing signalling devices and provisions for two days. Even with such a precaution the risk would be very great in a rough sea, and the chance of attracting the attention of ships would be small. It is understood that Mr. Hawker will not be able to send, but only to receive, wireless messages. This is unfortunate, for in the event of a forced descent the machine would take about ten minutes to glide from a height of 10,000 ft., and there would be ample time to get into communication with any vessels in the vicinity. It is intended to drop the under-

carriage of the Sopwith machine soon after starting, a gain of several miles per hour being thus rendered possible owing to the decreased head-resistance of the machine. A daylight landing is a necessity under these conditions, and a slight crash is inevitable.

The time of crossing is estimated at approximately twenty hours, and some interesting figures relating to this point given in a report of the Meteorological Section of the Air Ministry were referred to in last week's NATURE. These figures are based on the average of the weather reports available, and show that under the best conditions the time of crossing for a machine with a speed of 100 miles per hour, flying from west to east, is only 14½ hours in the month of April, and under the worst conditions 23 hours. The corresponding times for an east-to-west crossing are 21 and 36 hours. The advisability of a start from the American side is thus plainly demonstrated.

Although Mr. Hawker, with his Sopwith machine, was the first to be prepared for the start, it seems likely that prevailing bad weather will give other competitors time to get ready, and that the Atlantic attempt will be of the nature of a race. It is to be hoped that the desire to be first across will not lead any competitor to start before the weather conditions are reasonably favourable, as the risks are sufficiently great under the best conditions, and the loss of such experienced pilots as those engaged in the present attempt would be most regrettable. Meanwhile, every endeavour will doubtless be made to choose the best moment for the start, and we will hope that before many days are past a new and great triumph will be added to the annals of aeronautical science.

THE FOOD REQUIREMENTS OF MAN.

THE Food (War) Committee of the Royal Society has recently issued a report[1] on the food requirements of man and their variations according to age, sex, size, and occupation, which summarises existing knowledge in a manner intelligible to the ordinary citizen. The customary units of measurement are carefully defined, and it is suggested that the energy requirements of those engaged in various occupations should be estimated in terms of the amount of energy necessarily set free in the body to ensure equilibrium under the given conditions.

A provisional classification is into sedentary work, where the excess expended during eight hours' work over that transformed during eight hours' sleep is not more than 400 Calories; light work, the excess being 400–700 Calories; moderate work, 700–1100 Calories; heavy work, 1100–2000 Calories. The method is illustrated upon the data of Becker and Hämäläinen, the food requirements of males being found to vary from 2750 Calories for a tailor to 5500 for a woodcutter. In the following section the influence of external temperature is discussed, regret being expressed that the statistics of consumption during different months of the year are so inadequate that valid inferences cannot be drawn from them.

The energy requirements of women are dealt with on the same lines as those of men, the provisional figures ranging from 1783 Calories for a seamstress to 3281 for a laundress (net energy values), the food requirements of the average working woman being placed at 2650 Calories per diem.

In the following section the scanty data concerning the needs of children and adolescents are epitomised, and the report ends with a cautious description of the qualities of the proximate principles and their respective *rôles* in a dietary. The final sentence runs as follows: "The above report shows how very inadequate is our present knowledge of the science of nutrition, and demonstrates the necessity of renewed investigations of almost every point discussed in it."

We do not know whether this sentence, expressing the considered opinion of a committee fully representative of all departments of science concerned with the subject of animal nutrition, will be taken to heart by the Government and people of this country, but the measure of attention it receives will be a measure of the real acceptance by the nation of the gospel of science. Further progress in the science of nutrition chiefly depends upon the accumulation of accurate details. We already know, for instance, that the food requirements of a labouring man vary enormously with the nature of his avocation, and we also know how these requirements can be experimentally determined; we know that in the hand-working classes the proportion of the total income expended upon food often approximates to 50 per cent. This is the extent of our knowledge. Excepting the armed forces, there is not a single class of the community, not one occupational group, the average energetic needs of which have been measured upon a scale which entitles the measurements to be taken into serious consideration as data for estimating the income necessary to ensure the preservation of a fit standard of life or the general food requirements of the nation. To secure this knowledge—but one item in the long catalogue of defects—organised research extending over years is necessary, research neither particularly attractive in itself, nor calculated to yield spectacular results which can be made interesting to the readers of the daily Press. The contribution of each individual worker must be small; the ultimate value of the sum of results would be immense.

It remains to be seen whether we have the faith in science and the patience which will be necessary to replace the scattered fragments, which are all we now have, by a well-compacted body of exact information.

[1] Report on the Food Requirements of Man and their Variations according to Age, Sex, Size, and Occupation. Pp. 19. (London: Harrison and Sons, 1919.) Price 1s. 6d.

NOTES.

The Atlantic has not yet been spanned by aircraft, although two aeroplanes are reported as ready for the eastern flight, and at present are only waiting quieter and more favourable conditions in mid-Atlantic. Towards the close of last week much snow fell at St. John's, Newfoundland, rendering a start at that time impossible, but the weather conditions had become favourable for landing over the British Isles, and have continued so for some days, the weather during Easter being remarkably fine and clear. The *Times* for the early days of the present week shows by the bulletins of the weather conditions along the Atlantic course issued by the Air Ministry that the barometric pressure has been very high both over the British Isles and in Newfoundland; but, although the weather is fine and the winds are light, there is much fog over Newfoundland, extending eastward so far as 43° W. longitude. In central Atlantic the barometric pressure is lower than on either side, and the fog, together with the winds, "constitute unfavourable conditions for the flight." If the Air Ministry intends to say when the conditions in mid-Atlantic are favourable—and from the daily bulletins given there is an inference that it does—the Ministry undertakes a great responsibility. It commonly happens that with similar weather conditions to those now prevailing on either side of the Atlantic storm-areas are developed in mid-Atlantic, and follow a more northerly track than usual, drifting towards Greenland or Iceland. Before a start is made under present conditions it would. therefore, be worth while to consider the advantage of following a fairly southerly route, striking northwards on approaching the eastern side of the Atlantic. This would probably lengthen the distance somewhat, but it might lessen the chance of falling in with a storm.

A copy of the report of the secretary of the Smithsonian Institution of Washington for the year ending June 30, 1918, has been received. From it we learn that at the suggestion of the National Advisory Committee for Aeronautics the U.S. Council of National Defence appointed a committee, now known as the Aircraft Board, to consider all questions of aircraft production and to make recommendations to the military Departments for the production and purchase of aircraft and aircraft appliances. The experimental laboratory of the Advisory Committee has been erected at Langley Field, near Hampton, Va. The original Langley man-carrying flying machine, after several successful flights, is now exhibited in the U.S. National Museum. This machine is the first heavier-than-air man-carrying machine constructed, although it did not have a successful flight until more than ten years after its construction. The machine confirms the claim that the late Prof. Langley was the first to design and build a heavier-than-air machine capable of carrying a man in flight. The report points out also that the institution's researches and explorations were limited greatly during the year under review by war conditions. There was, naturally, unusual activity by members of the scientific staff in investigations related to Army and Navy operations. Several biological and ethnological expeditions have been held in abeyance, although some already in the field have continued in operation on a limited scale.

Last November the London Section of the Society of Chemical Industry invited M. Paul Kestner, the president of the Société de Chimie Industrielle, to deliver an address in London, and advantage was taken of this occasion to inquire whether it was possible to promote some co-operation between French and English chemists. M. Kestner, with characteristic public spirit, has during the last few months taken energetic steps to bring this about, and the recent conference held in Paris marks an important advance. Among those taking part in the conference were Prof. Chavanne (Belgium), Profs. Moureu and Matignon, M. Kestner, and M. Poulenc (France), Senator Paterno and Dr. Pomilio (Italy), Mr. Henry Wigglesworth, Col. Norris, and Dr. Cottrell (United States), and Sir William Pope, Prof. Louis, and Mr. Chaston Chapman (Great Britain). It was decided to form an inter-Allied confederation for pure and applied chemistry which should organise permanent co-operation between the various countries, and co-ordinate scientific and technical knowledge as well as contribute to the advancement of chemistry in its fullest extent. The inter-Allied council is to consist at the moment of six representatives from each of the nations mentioned above. The first meeting will be held in London on July 15–18, when the inter-Allied council will be the guests of the Society of Chemical Industry, the annual meeting of which then takes place. For the time being the secretary of the inter-Allied federation will be M. Jean Gerard, 49 rue des Mathurins, Paris. Particulars of the London meeting can be obtained in due course from Dr. Stephen Miall, 28 Belsize Grove, N.W.3.

On April 14 the Board of Agriculture and Fisheries was notified that a dog suspected to be suffering from rabies had been killed at Byfleet, Surrey. Post-mortem investigation proved that the dog was rabid. It had wandered from a house in Ealing on April 11, and during its three days' wandering is stated to have bitten five persons and several dogs. Two or three further cases of suspected rabies have since been reported in the London area. In consequence, the Board has made an Order prescribing the muzzling of dogs with wire-muzzles over an area which includes the whole of the counties of London and of Middlesex, nearly the whole of Surrey, and portions of Buckinghamshire, Hertfordshire, Berkshire, and Hampshire. It is to be hoped the necessary muzzles will quickly be forthcoming (at the moment of writing they are difficult to procure), that the authorities will rigorously enforce the Order, and that the public will support their action. It may be recalled that the similar Order by Mr. Walter Long in 1896–97 ensured complete immunity from rabies in this country for more than twenty years. Since rabies reappeared in Devon and Cornwall last September 150 cases have been reported.

At the annual meeting of the Society of Glass Technology, held on April 16 in the Applied Science Department of the University of Sheffield, Mr. W. F. J. Wood, president of the society, referred in his presidential address to the Research Association that has been formed in the glass industry. A provisional committee has been appointed, and at an early date all manufacturers in the industry will be invited to join the Glass Research Association. Substantial promises have already been received, and it is felt that the scheme will be a decided success. Sir Frank Heath, Secretary of the Department of Scientific and Industrial Research, also addressed the meeting. He pointed out that the glass industry had been engaging the anxious consideration of the Government as much as, if not more than, any industry in the country since the war began. During the war the Department had been enabled to help the industry in many ways, and would do so in the future. There was a great call from other industries besides that of glass for State aid in research. Research was insurance for knowledge, and he appealed to the Research Association to get the best men possible for their work. Mr.

S. N. Jenkinson has been elected president of the society for the ensuing year.

The annual meeting of the Society of Chemical Industry will be held in London on July 15–18. The King has consented to act as patron and the Prince of Wales as vice-patron. The opening meeting will be held at the Mansion House on July 15, when the Lord Mayor will extend the civic welcome, and Prof. Henry Louis will deliver his presidential address. Arrangements have been made for the delivery of an address by Sir William J. Pope, and for the holding of conferences on Empire sugar production, the leather, dye, and fermentation industries, and power plants in chemical works. Further particulars will be announced later.

On Tuesday next, April 29, Prof. A. Keith will give the first of a course of four lectures at the Royal Institution on British Ethnology: The People of Wales and Ireland. On Thursday, May 1, Dr. H. S. Hele-Shaw will give the first of two lectures on clutches. The Friday evening discourse on May 2 will be delivered by Prof. J. W. Nicholson on energy distribution in spectra; and on May 9 by Sir George Macartney on Chinese Turkestan: Past and Present. On Saturday, May 3, Prof. H. S. Foxwell will give the first of two lectures on chapters in the psychology of industry.

The spring and autumn meetings of the Institute of Metals will be held, respectively, in London on May 19 and in Sheffield on September 24–25. At the London meeting Prof. F. Soddy will deliver the ninth annual May lecture on "Radio-activity," for which cards of invitation may be obtained from Mr. G. Shaw Scott, 36 Victoria Street, S.W.1, upon receipt of a stamped and addressed envelope. The Sheffield meeting will be the first provincial gathering of the institute to be held since the war. The headquarters will be at the University of Sheffield.

With the view of giving archæologists and other people interested in the question of the antiquity of the human race an opportunity of examining some of the flaked flints found in the detritus bed beneath the Red Crag of Suffolk, Mr. J. Reid Moir has, with the co-operation of the council of the Royal Anthropological Institute, arranged for a good series of these specimens to be exhibited in the rooms of the institute, 50 Great Russell Street, W.C.1, for one month from Friday, May 2.

The subject for the Jacksonian prize of the Royal College of Surgeons of England for 1920 is "The Results and Treatment of Gunshot Injuries of the Blood-vessels." The subject for the next Triennial prize of the college is "The Anatomy, Morphology, and Age-changes of Cervical Ribs in Man, including a Description of the Associated Ligaments, Muscles, Blood-vessels, and Nerves."

We regret to see the announcement of the death of Mr. D. Rintoul, head of the physics department of Clifton College since 1885, when he succeeded the late Prof. A. M. Worthington in that post.

The life of the Rev. Stephen Hales, F.R.S. (1677–1761), is reviewed in an interesting article by Prof. F. Smith in the *Veterinary Review* (No. 1, vol. iii., 1919). Hales's work on experimental physiology, animal and vegetable, is well known, but his equally important researches in hygiene are apt to be overlooked. He devoted years of his life to the study of ventilation, and introduced, though not without considerable opposition, mechanical ventilation into prisons and ships. He also dealt with the ventilation of mines and hospitals, and noted that wounds healed better in tents with good ventilation than in foul air.

Acute infective polyneuritis is the subject of an article by Sir John Rose Bradford, E. F. Bashford, and J. A. Wilson in the *Quarterly Journal of Medicine* (vol. xii., Nos. 45 and 46). The disease is apparently a newly recognised one, characterised by generalised palsy of peculiar character. The clinical features and morbid anatomy of the disease are fully described. The disease has been transmitted to monkeys by inoculation of human spinal cord under the membrane of the brain. Very minute coccoid bodies are present in the spinal cord, and by the Noguchi culture method cultivations of a similar micro-organism were obtained. The organism measures $0{\cdot}2\mu$–$0{\cdot}5\mu$ in diameter, is rounded, oval, or kidney-shaped, and is difficult to stain. By dark-ground illumination it is merely a minute, highly refractile, undifferentiated body. The cultivations inoculated into monkeys reproduce the disease clinically and pathologically.

The annual report of the Scottish Marine Biological Association shows that, notwithstanding the absence of the superintendent, Lieut. R. Elmhirst, on naval service, the marine station at Millport continues to contribute valuable researches in several branches of marine biology. Dr. J. F. Gemmill has made progress with his study of the development of Asteroids, and has succeeded in rearing crosses between *Solaster endeca* and *Crossaster papposus* up to the commencement of metamorphosis. He has also reared and studied the early development stages of several anemones. Other researches mentioned in the report are those of Mr. J. S. Sharpe on calcium metabolism in molluscs, and on the action of guanidine on the neuro-myal system of decapod crustacea; of Mr. H. Leigh-Sharpe on *Calliobdella nodulifera*; and of Mr. James Dick on the medusæ of the Clyde. The usual educational work has been continued, the Nature-study classes for teachers being a successful feature.

We are glad to see that Australian ornithologists are paying increasing attention to the subject of the food of their native birds. In the January issue of the *Emu*, which has just reached us, Mr. Sidney Jackson comments on the inestimable benefits of the letter-winged kite (*Elanus scriptus*), which had established nesting colonies in the midst of an area of several hundred miles infested with millions of rats, on which they were feeding their young. Specimens of two species of these rodents were collected. The larger and more numerous was the long-haired rat (*Epimys longipilis*), the smaller the sordid rat (*E. sordidus*). The birds rested by day and hunted by night, when their prey came forth to feed. In the same issue Messrs. S. A. White and A. M. Morgan record the results of their examination of the stomachs of cormorants, which have lately been condemned on account of the supposed ravages they commit on food-fishes. They are able to show conclusively that the charges against these birds are absolutely without foundation, since no food-fishes were found, but only specimens of slow-moving species haunting weedy places, where their capture was easy.

In 1915 R. Dodge and F. G. Benedict, of the Nutrition Laboratory of the Carnegie Institution of Washington, published a volume entitled "Psychological Effects of Alcohol." In this book they recorded the results of an investigation upon the influence of alcohol on a number of physiological processes, including various reflexes and certain kinds of reaction-time, as well as other processes of more

psychological interest, such as memorising and the speed of free associations. They tested the effects of doses of 30 c.c. and 45 c.c. of absolute alcohol in ten subjects, and found a general depreciation of function on the days on which alcohol had been administered. One of their subjects showed the injurious effect of the alcohol in far less measure than the rest, although it produced certain general effects, such as sleepiness and a feeling of intoxication, which might have led one to expect the experimental tests to show a lowering of function. Dr. Walter R. Miles has now published a second volume entitled "Effect of Alcohol on Psycho-physiological Functions" (Washington, 1919), which is entirely devoted to a more extensive study of this apparently resistant subject. Using precisely the same methods as Dodge and Benedict, and working in the same laboratory under the same general conditions, Dr. Miles obtained results agreeing fairly closely with the general average of the earlier investigation. In twenty-seven out of thirty sets of results the effect of the alcohol was to lessen the value of the subject's performance, and in eleven cases this depreciation amounted to as much as from 10 to 37 per cent. The anomalous results of the first investigation seem to have been due to the effect upon the average of one or two days on which the subject had done especially well after he had taken alcohol.

THE remarkable richness of the flora of South-West China, especially in certain families, is illustrated by several papers by Prof. Bayley Balfour, W. W. Smith, and W. G. Craib which have recently appeared in the Transactions and Proceedings of the Botanical Society of Edinburgh (vol. xxvii., parts 2 and 3) and in the Notes from the Royal Botanic Garden, Edinburgh (vol. x.). The plants were collected mainly by Messrs. Forrest and Kingdon Ward. The place of honour is held by the Rhododendrons, in which genus fifty new species are described, including several from Upper Burma and Bhutan. There are also a number of new Primulas, some of which were collected in the Himalayas, a few striking autumn-flowering gentians, and two new genera of Gesneraceæ, as well as novelties in other families. Prof. Balfour also describes some interesting observations on Rhododendron seedlings, in which a juvenile character, the presence of an intense red colour, due to an anthocyanin pigment, on the undersurface of the leaf, persists for several years, and is gradually replaced by the peculiar hairiness which characterises the adult leaf. It is suggested that the change is correlated with a change in climatic relation. The young plant passes from a position in which its foliage is subject to the conditions of light, moisture, heat, and air-current belonging to a stratum at the soil-surface, to one some distance above the surface in which the same external factors operate in different intensity. Temperature and speeding-up of metabolism are prime considerations in the first environment, control of loss of water in the second. The anthocyanin development is an adaptation to the former, the hairy indumentum to the latter. Prof. Balfour also discusses, under the title "The Genus Nomocharis," a puzzling little group of lily-like plants from western China, which combine some of the characters of the true lilies and the fritillaries.

THE Experimental and Research Station at Turner's Hill, Cheshunt, an offshoot from the Rothamsted Experimental Station, continues its good work for nurserymen and market-gardeners growing under glass. The manurial experiments have been continued on substantially the same lines as in previous years, and have given practically the same results; again it is shown that farmyard manure is an efficient manure for cucumbers, and cannot adequately be replaced either by hoofs or bone-meal. Tomatoes, on the other hand, require potassic fertilisers and not so much nitrogen; indeed, in the experiments nitrogenous fertilisers have actually reduced the crop. Phosphates also had less effect than had been anticipated. The results recall those obtained at the Woburn Fruit Farm in their somewhat unexpected nature, and they bring out the necessity for a detailed physiological study of the phenomena of fruiting. The work on partial sterilisation has been extended during the year. Mr. W. B. Randall placed at the disposal of the committee a sum of money enabling it to appoint a special investigator, Mrs. D. J. Matthews (Miss Isgrove), who is studying the effect of various substances on the noxious organisms of the soil. Hitherto no agent has been found to be quite so effective as steam, and it seems possible that a mixture of substances will be necessary, one to deal with animals and another with fungi. A beginning has also been made with the study of the Noctuid moth, *Hadena oleracea*, which has become a serious menace to the tomato-growing industry; during the current year this work is to be extended considerably. A remarkable phenomenon is the zig-zag nature of the curve showing the yields of tomatoes on successive rows of plants. The outside row, as might be expected, shows the highest yield; the other rows give alternately high and lower yields. It is difficult to account for these observations, but the differences are greater than are obtained by differences in manuring. The report is full of interest to the plant physiologist.

ACCORDING to the Journal of the Franklin Institute for November, 1918, tests have been made to find the transmission factors for several slightly diffusive glasses for two kinds of illumination, viz. (1) a narrow beam of light perpendicular to the surface of the specimen, and (2) uniformly diffused light reaching the specimen from all directions above its plane, known as hemispherical illumination. The transmission-factor is, generally speaking, less for diffused (hemispherical) illumination than for the narrow beam of light. The transmission-factor of the glasses studied depends upon the position of the glass with respect to the source of light. For a narrow beam of light the transmission-factors are usually considerably greater when the rough surface faces the light than when the smooth surface is towards it. This is specially noticeable in ribbed glasses, but has not been noticed in etched glasses.

THE two sections of *Science Abstracts* for 1918 are now completed by the issue of the index parts for physics and electrical engineering. The former section extends to 575, and the latter to 492, pages, of which 62 and 37 pages are occupied by the indexes. The number of abstracts in the two sections is 1283 and 886 respectively, which are both 25 per cent. less than those of three years ago. The average length of an abstract, which has for some years been greater in the electrical engineering than in the physics section, has in the three years increased in both sections by 3 per cent. So far as can be seen from a glance through the volumes, this appears to be due to a relatively small number of abstractors supplying long abstracts rather than to a general increase in length of all abstracts. The art of conveying information in a few concise and readable lines is acquired only by practice, and a little editorial admonition might lead to a considerable improvement. Every physicist and every electrical engineer anxious to keep abreast of the times owes much to *Science Abstracts*, for without it his knowledge of what has been done in enemy countries during the last five years would have been very fragmentary.

REFERENCE has already been made in our "Notes" to the Admiralty salvage operations during the war. An article in the *Engineer* for March 21 gives an account, with illustrations, of the submersible salvage pumps and engines employed in these operations. It is not always convenient to supply current from a salvage vessel, and in such cases the electric current for driving the pumps is supplied by an oil engine-driven dynamo. It is essential that the plant should be weatherproof and unaffected by sea-spray or rain. Although a dynamo which will withstand being submerged has not yet been produced, the oil-engines described in the article are capable of being covered with water without coming to any harm. The engine cannot, of course, work while submerged. The necessity for an engine of this kind arose in connection with the installation of centrifugal pumps on a wreck situated in tidal waters, which had, owing to unforeseen circumstances, to remain in position while the tide rose and completely submerged the plant. A number of these engines have been built at the Bedford works of Messrs. W. H. Allen, Son, and Co. Up to the present there are two standard sizes, one with two cylinders of 12 brake-horse-power, and the other having four cylinders giving from 46 to 50 brake-horse-power.

AT the annual meeting of the Institute of Metals, held on March 25 and 26, the fourth report to the Corrosion Research Committee of the Institute of Metals was presented by Capt. Bengough and Dr. Hudson. The publication of this investigation, which is subsidised by the Department of Scientific and Industrial Research, has been considerably delayed owing to the request of the Admiralty that the results should not be made available during the war. The report is divided into three main parts. The first is devoted to the question of the nature of the attack which takes place when metals such as zinc, copper, and aluminium, and alloys such as 70:30 brass, corrode in neutral or nearly neutral liquids, *e.g.* distilled water and sea-water. The second section is devoted to the consideration of the behaviour of condenser tubes in similar liquids, and variations of behaviour in different samples of tubes of nominally the same composition. The third section is an attempt to set out in some detail a statement of the practical problems of corrosion in sea-water, which appear to the authors to be very different from what is usually supposed. A preliminary account is also given of experiments carried out with the object of testing an electrolytic process of protection and a pre-oxidising process designed for the same end. The authors express the view that corrosive attack on condenser-tubes is more diverse in character and complicated in nature than has been generally supposed. The first action is one of chemical oxidation, and secondary actions are of great importance. No one single remedy is likely to be found effective for all the different kinds of attack which occur in practice. The nature of the tube used and the protective measures chosen should be dependent on the particular set of conditions.

"CO-ORDINATION of Research in Works and Laboratories" is the title of a paper by the late Mr. H. R. Constantine read before the Institution of Electrical Engineers on March 27. A scheme is outlined in which it is proposed to place under the direction of a central board all the laboratories attached to the universities, colleges, and training institutions of the country, as well as many experimental laboratories connected with private works. The board would keep full records of what each laboratory was doing, and receive all inquiries for research work to be done; it would keep a record of results published all the world over. Further, the board would be invested with power to order any laboratory to undertake certain research work, or to leave another research alone, or, indeed, to transfer, if considered advisable, part of its equipment or *personnel* to another laboratory. Finally, all discoveries would be communicated to the board, which would have power to dispose of them after consideration of the rights of the individual worker. If adopted, the scheme would apparently supersede the Industrial Research Associations established already in connection with the Department of Scientific and Industrial Research, which has had a grant of 1,000,000*l.* placed at its disposal by the Government, and has been for some time actively at work. It is also as well to point out that the research work carried on in universities and other teaching institutions is conducted not wholly for the sake of the results looked for, whether purely scientific or technical, but for the educational purpose of training students in method. Moreover, as repeatedly pointed out, the original researcher in connection with fundamental problems will not usually be willing to unfold his ideas to others, at any rate in their early stages, before they have been tested.

AMONG forthcoming books of science we notice the following:—"Problems of Fertilisation," Prof. F. R. Lillie (*Chicago: The University of Chicago Press; London: The Cambridge University Press*); "Influenza: A Modern Account of its Pathogenesis, Symptoms, Complications, Sequels, and Treatment upon Combined Specific and Non-specific Lines," Sir T. J. Horder (*Henry Frowde and Hodder and Stoughton*); a new edition, thoroughly revised and enlarged, of "Practical Physiological Chemistry," S. W. Cole, with an introduction by Dr. F. G. Hopkins (*Cambridge: W. Heffer and Sons, Ltd.*); "Commercial Forestry in Britain: Its Decline and Revival," E. P. Stebbing; "Conifers: A Key to their Identity and Converse," C. C. Rogers, illustrated; "Tin," G. M. Davies; "Manganese," A. H. Curtis; and new and revised editions of "Heredity," Prof. J. Arthur Thomson, illustrated, and "Hydrographical Surveying: A Description of the Means and Methods Employed in Constructing Marine Charts," the late Rear-Admiral Sir W. J. L. Wharton, revised and brought up to date by Admiral Sir Mostyn Field (*John Murray*); "A Woman Doctor: Mary Murdoch of Hull," H. Malleson, and "Advance in Co-Education," edited by A. Wood (*Sidgwick and Jackson*).

OUR ASTRONOMICAL COLUMN.

CHANGES ON JUPITER.—Observers appear to be fairly well agreed on the character of the recent variations in some of the more prominent and durable of Jovian features. The Rev. T. E. R. Phillips, who has devoted much attention to Jupiter's appearance in recent years, says that the opposition of 1918–19 will be a memorable one. To his eye "the south tropical disturbance and the hollow in the southern belt have practically disappeared, but the red spot remains quite distinct on a night of good definition." The changes which have affected this particular region of the surface have been rapid and most remarkable. Mr. Phillips employs two instruments, one a $12\frac{1}{2}$-in. reflector and the other an 8-in. refractor. He regards it as likely to afford much satisfaction to observers that the red spot continues to retain a definitely elliptical outline, for the obliteration of this familiar marking would be regarded as a great loss by all students of the planet. That this object may at some future time regain its former (1878–80) conspicuous aspect is quite possible, and it should be attentively watched for changes of both shape and motion.

The Origin of Novæ.—Prof. W. H. Pickering examines various theories of the origin of novæ in *Popular Astronomy* for November last. He rejects the theory of collision of star with star on the grounds that novæ are too numerous for this and that the period of brilliance is too short. The first difficulty, but not the second, is avoided by the theory of collision of star with nebula; it would probably require years, not days, for a star, even at the enormous speed indicated by the spectroscope, to traverse a nebula of average size. Prof. Pickering prefers the hypothesis of a body of small planetary dimensions falling into the star and penetrating the photosphere to some depth before it exploded. He pictures its conversion into gas as being so rapid and violent as to scatter the materials of the photosphere to a considerable distance all round, thus producing an immense, but short-lived, increase of light. He notes that he is drawing on the star's own energy for the outburst, the falling planet merely acting as the trigger. The dark and bright bands of the spectrum are explained (as on many other theories of novæ) by the outer shells of gas being cooler, and so absorbing light, while the light from the gases streaming out on the remote side of the star, having its wave-length altered by motion, is not arrested by the cool gas on the near side. Newcomb, in "The Stars: A Study of the Universe" (p. 138), suggested a similar explanation, treating the stars as hollow globes of highly heated and condensed gas; a foreign body, on falling, might break the shell, when the interior gases would burst forth. "What magnitude the outburst might assume it is impossible to say."

Celestial Systems.—The Memoirs of the College of Science, Kyoto University (vol. iii., No. 7), contain a paper by Shinzo Shinjo and Yoshikatsu Watanabe on the angular momenta of celestial systems. The authors examine all the binary and multiple systems for which sufficiently accurate data are available (including eclipsing variables). They show that the resulting momenta are confined within tolerably narrow limits, and exceed several hundred-fold the angular momentum of the solar system. In studying the possible origin of angular momentum they examine the case of a spherical swarm of meteorites, and show that, for a given mass, the larger the individual meteorites the greater the probable momentum. To produce the momentum of the solar system they conclude that the individual meteorites must have been about 20 km. in diameter. The size would require to be much larger to satisfy the conditions of the binary systems. It is conjectured that swarms with the largest meteorites would condense into two or more nuclei, those with medium-sized meteorites into single orbs which would afterwards divide into two, those with meteorites 20 km. in diameter into planetary systems. In the case of dust-swarms or gaseous nebulæ, the number of constituents is so immense that the resulting angular momentum is infinitesimal. While the paper does not give a complete system of cosmogony, it sheds fresh light on some of the stages of the process.

COTTON-SEED BY-PRODUCTS.

On February 5, at the Royal Society of Arts, Mr. Ed. C. de Segundo read a very interesting and suggestive paper on "The Removal of the Residual Fibres from Cotton-seed and their Value for Non-textile Purposes." Mr. de Segundo explained that there are two main classes of cotton-seed, viz. the bald, black, or clean seeds, such as Egyptian, Sea Island, Brazilian, etc., of which practically the whole "lint" is removed by the process of "ginning," or separating the lint or textile fibre from the seed; and the white, woolly, or fuzzy seeds such as American, which are still covered with a short white "fuzz" or lint after ginning. Indian cotton-seed is really of the latter class, though the fuzz remaining on the seed is much shorter than in the case of the American.

To deal with these two classes of seed, two different methods have been adopted. The black seeds are crushed whole, and the residue after extraction of the oil is pressed into cattle-cake. The white seeds are first "delinted," which removes part of the short fuzz left on the seed after ginning, the machine used being practically the same as the saw-gin used for the ginning itself. The short fuzz or "linters" thus removed is used for guncotton, blotting-paper, waste, etc. The seed is then "decorticated," a process of separating the hull, with the fuzz still remaining on it, from the kernels or meats. The latter are then crushed alone, and the oil is taken out in a much purer form than is possible under the whole crushing process, because the presence of the hull or shell gives a darker colour to the oil. Incidentally, the process afterwards required to remove this dark colour gives the oil a slightly bitter taste, which made the value of such oils distinctly lower than those got by the decorticating process. The crushed kernels give a very fine residual product known as cotton-seed meal, which has recently been attracting particular attention because it has been shown to possess very high qualities as human food. Its protein and fat contents are very high, and mixed with potato- or wheat-flour it produces a most valuable form of food.

As it happens, the two processes above described have come to be known as the British and American processes respectively, because the British crushers have only had the opportunity of handling the Egyptian and Indian cotton-seed products in large quantities. The bulk of the American crop has, naturally, always been handled in the States. The Indian crop known as Bombay seed has always been imported into this country and crushed whole without previous delinting, because its seed-lint was scarcely long enough to be worth removing, and its presence in the cake (though it took long to convince the users of it that this was true) did no material harm if properly handled, while it gave a much bulkier, and therefore cheaper, cake.

The two improvements with which Mr. de Segundo has been connected are, first, the production of a machine which, after ginning and delinting in the ordinary way, takes a further quantity of "seed-lint" from the seed. This seed-lint is of considerable commercial value for many non-textile purposes, such as paper-making, artificial silk, explosives, and cellulose acetate, the peculiarity of the process being the very clean and pure condition in which it delivers the lint. Its removal also adds to the value of the seed for crushing purposes, saves freight by reducing its bulk, and minimises the danger of heating, and hence the risk of fire by spontaneous combustion. The second improvement is a process of removing the last vestige of fibre from the hulls after decortication, thus taking two further by-products out of the last residue of the former process. It was the first of these improvements that was mainly dealt with in the lecture.

The importance of these processes to the cotton industry is certain to be very considerable. There are many new areas in the British Empire where cotton is being developed, such as Uganda, Nigeria, and parts of the Sudan, where the woolly seeded varieties have been found the most suitable, but the seed has never been fully utilised because the crops were comparatively small, and the cost of handling

them under the disadvantageous conditions found in these areas was scarcely covered by the value of the by-products. But by increasing the value of these products the scale may be turned, and such a system rendered profitable, and it would certainly be an advantage to these areas to have such a supply of oil and cattle and other foods as these by-products would yield. Again, there are other areas where cotton is struggling against the rivalry of other competing crops, and where the scale might just be turned in its favour by the increased value of its by-products. Reference was made to the position of India, where the seed-crushing industry has never been properly developed, and it was agreed that such a process as the seed-lint removal might make all the difference.

A seed-lint defibrating machine was shown working at the lecture, and samples of all the by-products were exhibited, including bread, scones, and cakes made with a proportion of cotton-seed flour. There was a very useful discussion after the lecture by a number of experts representing different sections of the trades affected.

A BRITISH GEODETIC AND GEODYNAMIC INSTITUTE.

A COMMITTEE, consisting of Dr. Shipley (the Vice-Chancellor), Dr. H. K. Anderson, Col. Sir C. F. Close, Sir Horace Darwin, Sir F. W. Dyson, Dr. E. H. Griffiths, Sir T. H. Holdich, Sir Joseph Larmor, Col. H. G. Lyons, Prof. Newall, Sir Charles Parsons, Sir Napier Shaw, Sir J. J. Thomson, and Prof. H. H. Turner, has been formed for the purpose of making an appeal for the creation and endowment of a geophysical institute at Cambridge. The question of the establishment of an institute of this character has been under consideration by the British Association for the last three years. A large and representative committee reported unanimously in favour of the project, which was then considered by the Conjoint Board of Scientific Societies. This Board also reported that there was a real need for such an institute. The chief reasons which have been put forward on behalf of the scheme are:—(1) Geodetic work must form the basis and control of all the State surveys of the Empire, on which about a million sterling was spent annually before the war. (2) A geophysical institute could render great assistance in connection with the particular group of geodetic problems now of most practical interest in the United Kingdom, namely. those associated with levelling, mean sea-level, and vertical movements of the crust of the earth. (3) Such an institute is greatly needed to assist in the study of the tides and in attacking the great problems which must be solved if tidal prediction is to advance beyond its present elementary and fragmentary state. (4) There is at present no provision for the collection and critical discussion of the geodetic work which is being done within the Empire, or for its comparison with the work of other countries. There is no institution available for research work or higher training in geodesy. There is no British institution which can be referred to for the latest technical data and methods, and until the outbreak of war it was the custom of many British surveys (notably the Survey of India), when confronted with geodetic problems, to refer to the Geodetic Institute at Potsdam. This was not even then a very satisfactory arrangement, and now a radical change is inevitable.

Discussion as to where the institute could most suitably be established has led to the selection of Cambridge, for it is essential that an institute of geodesy and geodynamics should be closely associated with a great school of mathematics and physics, and it is only in connection with a great Imperial university that that width and freshness of outlook are to be sought which are essential to a progressive and practical science. The committee has evidence that an institute at Cambridge would be cordially welcomed by the national Survey Departments, both terrestrial and oceanographic.

It is estimated that an endowment of 50,000*l.* will be necessary if the proposed institute is satisfactorily to perform the double task of research and education, but it is hoped that if half that sum were contributed by private benefactions the remainder would be forthcoming from national funds. An essential part of the scheme would be the foundation of a university professorship of geodynamics to be held by the director of the institute. To place this professorship in line with other chairs recently endowed by private benefactions, and usually associated with the names of the donors or founded as memorials of national sacrifice in the great war, a sum of 20,000*l.* (which is included in the 50,000*l.* mentioned above) would be required. It is certain that all who have to do with our shipping interests or with aerial navigation would ultimately profit from the establishment of such an institute.

RESPONSIBILITIES OF BOTANICAL SCIENCE.

"SOME Responsibilities of Botanical Science" is the subject of Prof. B. E. Livingston's address to the Botany Section of the American Association for the Advancement of Science meeting at Baltimore last December (*Science*, February 28, 1919). The work of botanical science is at present carried on by a sort of guerrilla warfare, each man for himself; for a planned and productive campaign co-operation is necessary. The objects to be attained are twofold. The first is the conservation of knowledge already attained. The existing means for presenting botanical abstracts and *résumés* are merely makeshifts; there is need for a national or international institute for the furnishing of bibliographical information on request. Such an institute would be a great undertaking, with a permanent staff of departmental heads and a corps of bibliographical assistants; but it would seek the co-operation of all men of science. It would avoid enormous waste of time and energy on the part of scientific workers and research institutions, and give congenial employment to many who wish to serve in scientific work, but may not find their best places as teachers or research workers.

The second object is botanical research, which is considered under three heads: the planning of research, the procuring of data, and the interpretation and presentation of results. Prof. Livingston emphasises the absence of any recognition of the investigator as such, and the striking characteristic that most of the published work appears to be done by apprentices. The planning of scientific investigation deserves much more attention than it generally receives, and our selection of problems and planning of projected investigations would be greatly improved if co-operation between competent thinkers were more in vogue. The securing of the requisite observational or experimental data is the easiest part of investigation, but comparatively few writers trouble to interpret their results in a logically complete manner. A discussion is written from the point of view of one out of several or many logically possible hypotheses, and one of the greatest wastes in biological research lies in the publication of so many uninterpreted observations. Finally, there are the responsibilities towards applied botanical science, not only the practical applications in the arts, but also the philosophical applications to other branches of science.

OPHTHALMOLOGICAL TRAINING OF MEDICAL STUDENTS.

THE Council of British Ophthalmologists has issued a report dealing with the teaching and examination of medical students in ophthalmology. The first part of the report reviews briefly the efforts made up to the present by the General Medical Council to ensure better training of the medical student in this important subject. These, unfortunately, have not succeeded in their object, and it is still the case that "the general body of the medical profession does not possess a competent knowledge of diseases of the eye."

The second part of the report deals in detail with the requirements of all the examining bodies in Great Britain and Ireland and, for comparative purposes, with a large number of Colonial, American, and foreign universities. The analysis of these requirements shows that Great Britain stands almost alone in granting diplomas to practise medicine without evidence of an adequate knowledge of diseases of the eye. In Ireland and in the great majority of foreign and Colonial universities ophthalmology is one of the subjects of the qualifying examination, and the examinations in it are conducted by ophthalmic surgeons.

The council has therefore recommended (1) that no student shall be admitted to the final examination, qualifying to practise medicine, unless he has attended an ophthalmic clinic for not less than six hours a week during a period of three months, and has attended a course of systematic instruction in ophthalmology; and (2) that no student shall be considered to have passed the qualifying examination unless he has shown a sound knowledge of practical ophthalmology in an examination conducted by ophthalmic surgeons.

CLOCK ESCAPEMENTS.[1]

THE most ancient instruments for measuring time were probably some kind of sundial. Something of the kind is, no doubt, referred to in 2 Kings xx. and Isaiah xxxviii., where it is stated that the shadow moved back ten steps on the steps of Ahaz (for that is the literal translation). Herodotus ("Euterpe," cix.) tells us that the Babylonians introduced to the Greeks the *πόλος* and the *γνώμον*, no doubt some forms of sun-instruments. Frequent allusions are found in the classics to the clepsydra, which was made in various forms, always depending, however, upon the approximately uniform flow of water through a small hole.

But clocks, properly so called, cannot be traced with certainty earlier than the fourteenth century. In 1348 a curious iron clock was sent over from Switzerland, and was until recently kept in Dover Castle. It is now in the Science Museum at South Kensington. It is interesting as having no pendulum or balance-spring (both much later inventions), but, instead, a vertical spindle carrying a horizontal traverse loaded at the ends with weights. This vertical spindle has two pallets projecting from its sides, approximately at right angles to each other, which engage alternately the uppermost and lowermost tooth of a contrate wheel the axis of which is horizontal and in the same plane with the vertical axis first referred to. This is the "verge" escapement, which was for long afterwards used in both clocks and watches. No good timekeeping was possible with such an arrangement. Gravity did not come into the problem, and the speed of the movement was only restrained by its energy having alternately to create and destroy angular momentum in the swinging arms. The force of the train, however variable, was paramount.

[1] From a discourse delivered at the Royal Institution on February 21 by A. T. Hare.

The next step in horology, and undoubtedly the most important which has ever been made, was the application of the pendulum to clocks by the Dutch physicist and astronomer, Christian Huygens, in 1657. Galileo had discovered, about sixty years earlier, the isochronism (since found to be only approximate) of a swinging body, but, in spite of efforts made after his death to claim priority for him in the invention of the pendulum clock, the evidence has not convinced historians of his title to that honour.

Huygens, being aware of the fact that the motion of a particle under gravity was only isochronous, independently of the extent of the arc of swing, when the body describes a cycloid, and knowing the property of that curve to reproduce itself as an involute of an equal cycloid, attempted to secure the desired isochronism by suspending his pendulum from a silk thread which swung between two cheeks of brass cut to the shape of the cycloid, thus obliging the bob to trace an involute. But the silk was so affected by the weather that no good result ensued.

Another objection to the verge escapement was the large arc of swing necessary to permit the escapement to unlock itself. Huygens attempted to overcome this difficulty by making the verge the axis, not of the pendulum-crutch, but of a pinion gearing into a larger wheel to the arbor of which the crutch was attached. This construction permitted the angle of swing to be reduced at pleasure, but more friction was introduced, and little improvement was effected.

The calculation of the time of swing of a free pendulum describing a circular arc can only be made approximately, but the approximation can be carried as far as desired, and as the arc of swing is never large, a few terms suffice. This is the formula:—

$$\mathrm{T}=\frac{\pi k}{2\sqrt{gh}}\left(1+\frac{1}{4}\sin^2\frac{\alpha}{2}+\frac{9}{64}\sin^4\frac{\alpha}{2}+\ldots\right)$$

from which, by differentiation,

$$\frac{d\mathrm{T}}{d\alpha}=\frac{\pi k\sin\alpha}{16\sqrt{gh}}\left(1+18\sin^2\frac{\alpha}{2}+\ldots\right).$$

Here T is the time of swing of the pendulum from its highest position to the vertical, and α is the semi-angle—that is, the angle turned through from the highest to the lowest position. Now of the factors making up the expressions on the right-hand side of these equations, only π and g and the numerical coefficients can really be considered as constant. It has been suggested that even g may one day be shown to be variable. As for h and k—that is, the distance from the axis of motion to the centre of gravity and the radius of gyration respectively—these are well known to be dependent on temperature, and an interesting account might be given, if time permitted, of the evolution of the compensated pendulum. The recent discovery of alloys of iron and nickel the coefficient of expansion of which is very low has much facilitated this.

The factor which has most influence on the value of T is α, the angle of swing. The formulæ show us two things: first, that the wider the arc of swing the more a clock will lose, and, secondly, that a given small variation of arc is less harmful when the whole arc is small than when it is great. There are practical reasons, however, for not making it *too* small, which have led to the adoption of arcs of two or three degrees on each side of the vertical as, on the whole, the best.

This table gives the losing rate for variations of arc:—

Semi-arc	Daily loss	Difference
° ′	s.	
0	0	
0 15	0·1	0·1
0 30	0·41	0·31
1	1·65	1·24
1 30	3·70	2·05
2	6·58	2·88
2 30	0·28	3·70
3	14·31	4·53
3 30	20·16	5·35
4	26·33	6·17
4 30	33·32	6·99
5	41·14	7·82

It must be remembered that these figures only relate to a *free* pendulum, and with some escapements the errors introduced mask this result completely.

Many attempts, some of great ingenuity, were made to get better results from the verge, especially as regarded the reduction of the arc, but they were all superseded by the anchor, or recoil, escapement, invented (most probably) by the celebrated Dr. Hooke, and first made by William Clement in 1675. This is the escapement still used in all common clocks, but it has disadvantages which render it unsuitable for high-class work. The train exercises great "dominion," as it used to be called, over the pendulum, and is assisting gravity the whole time, hindering the rise of the pendulum and accelerating its fall, so that T may be considerably diminished when the train has been recently oiled without any corresponding variation of α.

But in 1715 George Graham, pupil of Tompion (both of whom were so esteemed as to be accorded burial in Westminster Abbey), made a most important modification of the anchor. He removed most of the flukes, leaving only a small sloping part near the tip, by sliding along which the extremity of the scape-wheel teeth could give the necessary impulse to the pendulum. The rest of the fluke he fashioned so that it should be a portion of a circle having its centre on the axis of the crutch-arbor, thus entirely preventing recoil of the movement, and, to a great extent, releasing the pendulum from the "dominion" of the train. During the time when the circular part of the fluke is passing along the tooth of the scape-wheel the motion of the train is entirely held up, and it is neither doing work on the pendulum nor having work done on it. The device is consequently known as the "dead-beat."

Numbers of escapements were devised after Graham's invention, which, though differing much from it in design, were, nevertheless, broadly speaking, mechanical equivalents of it. Such were Thiout's, Vérité's, Perron's, Leonhard's, Vulliamy's, Robert's, Berthoud's, Lepauté's, and Brocot's.

The designer of a turret-clock, however, always has in mind the serious variations in the force of the train caused by wind or snow on the hands, as well as by the thickening and drying of the oil on the bearings and the cutting and wearing of the pivots and of the teeth of the wheels and pinions. It was, therefore, long ago recognised that the proper function of the clock-train was not to drive the pendulum, but to record the number of its swings—that is, to tell the time—and to keep wound a smaller clock which should be independent of these disturbances, and could be made very simple, and even reduced to one wheel, if often enough rewound. This construction was proposed by Huygens, who did so much for the science of accurate timekeeping. The principle of these "remontoirs," as they are called, is very much the same in all. Some rewind a little weight, others keep a spring wound, but in every case, directly or indirectly, the pendulum has to unlock the rewinding mechanism by means of some device which is itself an escapement, and this cannot be effected without some friction.

From the train-remontoir it is an easy step to the next great improvement. The question naturally arises: "Why rewind the train in the middle? Why not simply relift the pallets and let them fall by gravity on the pendulum?" This question was answered about the year 1716, when Alexander Cumming produced the first of the series of gravity escapements which have done so much to make the accurate turret-clock a possibility. His escapement is rather complicated and has several points where there is friction, and very soon after it was greatly simplified and improved by Thomas Mudge, a pupil of Graham's. Fig. 1 shows Mudge's escapement, and will be easily understood.

The tooth marked 1 has just lifted the gravity piece A′B′, and is resting on the dead face. The pendulum, moving to the right, is just about to lift the gravity piece, causing the dead face to slide along the tooth until it is clear of it. The wheel is then free to turn further, and the tooth marked 2 lifts the other gravity piece AB in a similar way. When

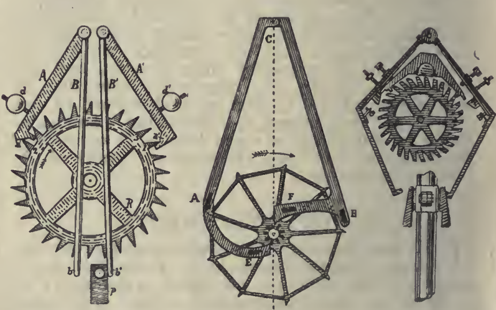

Fig. 1. Fig. 2. Fig. 3.

the pendulum has attained its maximum elongation to the right (carrying A′B′ with it) and begins to return, the pallet on A′B′ falls midway between teeth 1 and 3, thus falling rather farther than it rose, the balance of work done on the pendulum serving to maintain the latter in motion against the resistances. Each gravity piece is lifted by the wheel at a time when the pendulum is out of contact with it, and so the action of the train cannot disturb the pendulum except by the friction of the dead faces.

There is, however, a source of error to which Mudge's escapement is liable which was sufficient to condemn it. The driving power had to be ample, and there was danger either that the gravity pieces might be thrown clean off the wheel, allowing the latter to race and destroying all timekeeping, or that, if this complete "tripping" did not occur, they might, at all events, be thrown a little too high, so that the teeth of the scape-wheel, instead of resting in the exact corner, as tooth 1 is seen to be doing, would rest on the dead face nearer its extremity, and probably hold up the gravity piece, by friction, higher than it should. This fault was called by Lord Grimthorpe "approximate tripping," and if it occurred the constancy of the maintenance would be lost. This might probably have been cured by the use of a dashpot,

with which Mudge's escapement would have been very considerably improved.

Mudge's escapement was followed by Bloxam's, the action of which will be obvious from Fig. 2. It is still to be seen in action in Bloxam's own clock, which is now, by his nephew's permission, at the Science Museum. The noteworthy feature in it is that the locking arms are much longer than the lifting teeth, so that the friction of unlocking is much reduced.

It was on Bloxam's design that Lord Grimthorpe improved in the construction of his well-known "double three-legged gravity escapement," used for the first time in the great clock in the Houses of Parliament. The principal feature in this escapement is the long wind-fly, which moderates the shock of impact of the teeth on the pallets, and which the large angular movement of the scape-wheel (60° at each tick as against 20° in Bloxam's) rendered effective.

A new principle was introduced into the gravity escapement by Capt. Kater about the year 1840, and is described in vol. cxxx. of the Phil. Trans. Fig. 3 is taken from Kater's paper, and shows clearly the design. The gravity pieces are lifted alternately as in Mudge's and Bloxam's constructions, but they do not themselves unlock the escapement, merely serving to upset the equilibrium of a heavy piece (seen in the figure above the wheel), which does the unlocking, but, owing to its high moment of inertia, gets slowly under way and so unlocks the wheel only when the gravity piece then in contact with the pendulum is no longer touching it.

Vérité produced a gravity escapement in which pivot friction was got rid of, but this escapement had four little balls hanging from four silk threads, and was somewhat delicate and complicated.

It occurred to me some time ago that Kater's principle might be applied in such a way that the pendulum should be entirely freed from all friction whatever, while the impulses given to the pendulum were exactly uniform. A full description of this escapement will be found in Patent Office Specification No. 113,501, but it may be said, very briefly, to consist in two little weights which rest alternately on the two ends of a rocking frame having considerable moment of inertia, and on two little upright stems at the ends of arms fastened to the pendulum near its point of support. When the rocker is horizontal, and the pendulum at rest and vertical, things are so adjusted that the weights are resting indifferently on both the pendulum arms and the ends of the rocker. If, then, the pendulum is pushed to one side, say the right, it carries the right-hand little weight upwards, relieving the rocker of its weight, and deposits on the opposite end of the rocker the other little weight. This upsets the equilibrium of the rocker, which commences to turn over, and so releases the scape-wheel, which turns the rocker back rather beyond the horizontal in the sense opposite to that of its last motion, so that when on its return the pendulum again exchanges weights with the rocker, it deposits the right-hand weight at a lower level than that at which it was picked up. The escapement is simple, and a clock fitted with it has given results which are encouraging.

Before concluding, I must refer to a remarkable series of papers which commenced last year to appear in the Proceedings of the Royal Society of Edinburgh by Prof. R. A. Sampson, the Astronomer Royal for Scotland. Prof. Sampson is, as all astronomers must be, much interested in accurate timekeeping, and has experimented with three different clocks, having escapements which I must very briefly describe. One is by Mr. Cottingham, and is essentially the same as an escapement which the late Sir David Gill, then Astronomer Royal at the Cape, had imagined. The pendulum is driven by a gravity piece which, so long as it is in contact with the pendulum, by that very contact completes an electric circuit which holds up an armature against the poles of an electromagnet. This armature is itself the stop which limits the travel of the gravity piece. The latter, therefore, goes on impelling the pendulum until it is brought up against the armature. When this happens the gravity piece is left behind by the pendulum and the circuit is broken. At once the armature falls against a stop, and the gravity piece is lifted, so that the pendulum takes it up again at a higher level than that at which they parted company. Sir David Gill found trouble from the slight adhesion which exists between two metallic surfaces when a current is broken between them, and gave much attention to experiments designed to avoid this. I do not know how far he succeeded, but it seems clear from Prof. Sampson's paper that the escapement is very successful now. The idea has probably occurred to many people. I began making a clock about thirty years ago on what was practically the same principle, but gave it up because at that time it did not seem practicable to find a battery capable of giving a current lasting nearly half a second for each second that passes.

Another of Prof. Sampson's clocks is driven by an escapement invented by Riefler, of Munich, which is unlike any of those we have been considering, and in which the necessary energy is communicated to the pendulum by bending the suspension spring. The block from which the suspension spring hangs, instead of being fixed as immovably as possible, which it generally is, is supported on knife-edges, and the suspension spring, which, of course, always tries to keep straight, causes the block to turn on these edges, and so unlock the scape-wheel, which bends the spring back against the motion of the pendulum and thus keeps it going.

The third escapement which is being observed at Edinburgh, and the last I propose to refer to, is that adopted by the Synchronome Co., and belongs to the class where the action takes place at the bottom of the pendulum or of the crutch instead of the top. This is fully described in the specification of a patent granted to Mr. Shortt, and numbered 9527 of 1915.

So much for escapements.

We may, in conclusion, for a moment review the difficulties attending the accurate measurement of time and note how they have been attacked.

If ever a perfect clock is constructed it will certainly be a pendulum clock, and it will have to fulfil two conditions, necessary and sufficient. They are these:—First, the moment of inertia of the pendulum must be invariable; and, secondly, the forces which act on it must be invariable. If these two conditions could be fulfilled, the last word in horology would have been said. So far, of course, neither condition has been fulfilled, but surprisingly good work has been done. As for the first condition, that the moment of inertia must be invariable, the chief difficulty is to avoid change by change of temperature. There are two ways of diminishing this change. The pendulum must be compensated in one of the well-known ways—by Harrison's gridiron construction; or that of Graham by the expansion of mercury in the bob; or, again, by the zinc and iron combination used in many turret-clocks; or, best of all, by availing ourselves of the low expansion nickel-steel recently introduced by Guillaume. Also, for added security, the whole clock must be enclosed in a thermostatic

chamber, as is done by Prof. Sampson at the Royal Observatory at Edinburgh. The other condition is much more difficult. There is, besides the almost inevitable friction of the escapement, the effect of the buoyancy of the air. This last can be avoided by enclosing the whole clock in a glass case, tightly fitted, in which the air can be slightly rarefied and maintained at a constant pressure below that of the atmosphere. This would seem to offer a very satisfactory solution of the difficulty. Temperature error and buoyancy error having thus been to a great extent mastered, we come back to the forces connected with the maintenance and recording of the motion as the principal sources of uncertainty. And let no one suppose that little has been effected. Perfection in this, as in other human pursuits, is doubtless unattainable, but we approach it asymptotically, and we are farther along the asymptote than might be imagined. Prof. Sampson tells us that in his thermostatic chamber and barostatic cases, and with the Riefler, Cottingham, and Synchronome escapements which he is studying, the errors average no more than one-hundredth of a second per day—that is, at the rate of one minute in sixteen years, if the clock could run so long without stopping—truly an almost miraculous accuracy, unrivalled, I imagine, in any physical measurement. Anyone, therefore, who hopes to improve upon this has a difficult task before him. If it is true that *le mieux est l'ennemi du bien*, it must be acknowledged that *le mieux* has against him a most formidable antagonist.

[The lecture was illustrated by a number of working models.]

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Edinburgh.—Dr. James Drever has been appointed Coombe lecturer in psychology.

The University Court has resolved, subject to the approval of the Senatus and to the co-operation of the Town Council, to invite the British Association to hold the annual meeting in 1921 in Edinburgh.

An important step has recently been taken in the purchase of 100 acres of land for University extension. The land lies on the south side of the city, about two miles from the present University, and in the neighbourhood of the Royal Observatory on Blackford Hill. There will be ample scope in the immediate future, not only for the building of laboratories and hostels, but also for accommodation for sports and athletics.

Glasgow.—The following doctorates were among the degrees conferred on April 22:—*M.D.*: W. E. Boyd. Thesis: "The Colloidal State of the Blood Serum and its Electrical Reactions." *D.Sc.*: D. Burns. Thesis: "On the Physiological Significance of Guanidin, especially in its Relation to Creatin-Creatinin Metabolism," with other papers.

The standard of education in Central Europe presents notable divergences from that to which we are accustomed. It is measured by the percentage of illiterates among those who exceed the age of six years. As one goes east the percentage increases. Among the northern Slavs, the Czechs are well educated, their percentage being 4; next come the Slovaks with 20 per cent.; then the Poles of Galicia with a percentage twice that of the Slovaks; and finally there are the Ruthenes, or Little Russians, of Galicia, Hungary, and the Ukraine, with a percentage of 80, double that of the Poles. Among the Slavs of the south, the Slovenes who border on Italy have a percentage of 20; then come the Croats with a percentage of 60, and the Serbs with one of 70. Between the two branches of Slavs lie the Italians, who vary from 7 to 40 per cent. in illiteracy; the Germans of Austria, whose numbers lie between 2 and 20; the Magyars of Central Hungary, who are about as well educated as the Slovaks or Slovenes; and, finally, the Rumanians of Transylvania, three out of four of whom are illiterate. These differences are a result of two factors: first, nearness or remoteness from Western civilisation, and, secondly, religion—the western folk are Roman Catholics and the eastern folk adhere chiefly to the Greek Church.

A copy of the calendar for 1917–18 of the Imperial University of Tokyo has been received. The calendar is published biennially, and an examination of the present issue serves admirably to illustrate what rapid strides in the provision of facilities for higher education have been made in Japan in recent years. Among other constituent colleges of the University the calendar deals with the College of Science, and gives full particulars of the extensive collections of specimens in the Natural Science Department and of the numerous adjuncts with which the college is provided; for instance, the Tokyo Astronomical Observatory, the Botanic Gardens of forty acres at Koishikawa, the Seismological Observatory, and the Marine Biological Station at Misaki, primarily intended for the use of instructors and students of the University, but available for other workers in biological research. Similarly, in connection with the flourishing College of Agriculture, every facility seems to have been provided. There are farm, nursery, and botanical gardens; laboratories for agricultural chemistry, forestry, fisheries, and for studying silkworm diseases, as well as numerous museums devoted to specific objects. A veterinary hospital is situated in the grounds of the college; a pomological garden has been laid out in Rokugo; and there are nine forests attached to the college. The University also includes an institute for the study of infectious diseases, where are arranged the investigation of the etiology, prophylaxis, and treatment of infectious and parasitic diseases, and experiments with disinfecting, prophylactic, and curative agents. The calendar runs to 402 pages, which teem with interesting particulars concerning the activities of the other faculties, and is illustrated also with charts, diagrams, and plans to make clear the working arrangements of this centre of higher learning.

The British Science Guild has just issued a memorandum on the question of the appointment of a Departmental Committee to inquire into the existing provision of university and higher technical education in the United Kingdom, and also as to the desirability of appointing a consultative committee, including representatives of industry, to advise the Board of Education in matters affecting the relationship of science and industry to education. It is now thirty-seven years since the fruitful inquiry by a Royal Commission was held as to the provision for scientific and technical education, not only in this country, but also in Europe generally and the United States, which revealed our serious deficiency, and led ultimately to the adoption of the Technical Instruction Acts of 1889 and 1891, and to the valuable results which ensued. It is felt that the time is ripe for a further inquiry as to our present facilities for scientific and technical education with the view of ascertaining how far it is adequate to the needs of our chief manufactures in face of the great advances made abroad in the chemical, iron and steel, textile, optical glass, and other important industries. Especially is it desirable to learn what means exist for the encouragement and

adequate training of efficiently educated youths as leaders in our chief industries and what number avail themselves of such training. Certainly it would be found far below that of Germany or the United States, our chief industrial competitors. Inquiry should also be made as to the disposition of our chief technical institutions, especially those equipped for the efficient training of *day* students, and as to the desirability of the official recognition of such institutions as specialise in the science and technology of certain industries, *e.g.* iron and steel at Sheffield; cotton textiles and chemical products, particularly dyes, at Manchester; the leather industry at Leeds; shipbuilding at Glasgow, Newcastle, and Belfast; mining at Wigan, Newcastle, and Cardiff; textiles other than cotton at Leeds, Huddersfield, and Bradford; mechanical and electrical engineering at various chief centres, etc. There is reason to believe that public opinion is ripe for much larger support both from local and State funds. The new Education Act will certainly add largely to the number of capable students who will need the help of maintenance scholarships, which should, in consequence, be very largely increased, so as to enable them to proceed to higher institutions for whole-time study. It is to be hoped that this important memorandum will be circulated to every Member of Parliament and to all the education authorities and chief industrial associations throughout the kingdom.

SOCIETIES AND ACADEMIES.

London.

Optical Society, April 10.—J. W. **French**: The unaided eye. After a brief historical introduction, the principal dioptric features of the eye were considered, particularly those relating to the pupil reflexes. By means of a simple pupilometer the diameter of the pupil when applied to optical instruments was measured. The variations of the pupil with varying illumination of the whole retina, of the macula lutea, and of several zones of constant area were also measured and the results discussed. It would appear that for the macula lutea the pupil area varies as the fifth root of the illumination. The zone around the macula lutea is more sensitive, and the sensitiveness diminishes thereafter towards the margin of the retina. So far as the pupil reflexes are concerned, the two eyes are quite independent of each other; while the pupil area of the one eye under constant illumination remains constant, the other eye under simultaneous variation of the illumination varies in accordance with the above law. The variation of the pupil area with accommodation is quite independent of the illumination, and is determined by the refractive power of the crystalline lens.—T. **Smith**: The spacing of glass-working tools. In constructing optical systems the exact curvatures for the surfaces determined by calculation need not be employed, but the departures must lie between limits which will be functions of the nominal curvatures. It follows that a system of properly spaced tools should suffice to meet all normal requirements. The basis on which a system should be constructed is discussed, and a proposed standard list of tools is derived from an aberrational condition, together with assumed extreme relations between aperture and focal length and between aperture and radius of curvature. The total number of tools, which is finite, occurs as an independent variable in the formula on which the system is constructed, and in the absence of experimental investigations this must be determined by comparing the results obtained from an arbitrarily assumed value with the lists that manufacturers have found from experience to be reasonably spaced. A comparison between the list derived by assuming the total number of different curvatures in the complete set to be one thousand and the lists of two makers shows satisfactory agreement.

Paris.

Academy of Sciences, March 31.—M. Léon Guignard in the chair.—A. **Lacroix**: The leucitic lavas of Trebizond and their transformations. From the data furnished by chemical analyses it is impossible to get an exact idea of the magmatic relations of these rocks, since the essential ratios are disturbed by chemical and mineralogical transformations of secondary origin.—G. **Bigourdan**: The observatory of Le Monnier in the rue Saint-Honoré. Historical account of Le Monnier's astronomical work and publications, and of his instruments.—Ch. **Barrois** and P. **Pruvost**: The stratigraphical divisions of the Coal Measures of the North of France.—H. **Douvillé**: Evolution and classification of Nummulites.—C. **Richet** and H. **Cardot**: Sudden mutations in the formation of a new race of micro-organisms. A study of the modification produced by an arsenical medium upon the production of lactic acid by a pure lactic organism. This organism does not gradually become accustomed to the poison, but the tolerance shows a series of sudden variations, each of which is marked by intense multiplication.—M. **de Sparre**: Conditions to be fulfilled for increasing the flow, and hence the work, in an hydraulic installation without modifying the pipe.—G. A. **Boulenger**: An interesting case of sexual dimorphism in an African snake, *Bothrolycus ater*.—M. Eugène Casserat was elected a non-resident member in succession to the late M. H. Bazin.—P. **Sabatier** and G. **Gaudion**.—Catalytic dehydrogenation by nickel in presence of hydrogen. Pinene, limonene, camphene, menthene, and cyclohexene carried by hydrogen over nickel at 350°–360° C. undergo simultaneously hydrogenation and dehydrogenation. The reaction has been applied to compounds containing oxygen. Cyclohexanol gives phenol; pulegone, a mixture of cresol and thymol.—S. **Lefschetz**: The analysis of algebraic varieties.—L. E. J. **Brouwer**: The enumeration of regular Riemann surfaces of Genus I.—A. **Véronnet**: The temperature of equilibrium of a gaseous star for any ray.—A. **Colson**: The theory of solubility.—C. **Chéneveau** and R. **Audubert**: Absorption in turbid media. Dispersion by internal diffusion.—P. **Vaillant**: The production of a continuous current by the application of an alternating electromotive force to a voltameter with platinum electrodes.—J. **Martinet**: The mobility of the hydrogen atoms in organic molecules. The action of phenylhydrazine on dioxindols. Although neither aldehydes nor ketones, dioxindols give phenylhydrazones with great ease. The preparation and properties of several of these phenylhydrazones are described.—G. **Guilbert**: Some examples of "cyclone compression." Cyclonic centres sometimes present the phenomenon of disappearing very rapidly, in twenty-four hours or even less. This the author terms "cyclone compression," and directs attention to several examples which have occurred recently.—A. **Jauffret**: The determination of the woods of two species of Dalbergia from Madagascar, according to the characters of their colouring matters. The colouring matters extracted from these two species by solvents give different chemical reactions and absorption spectra. These characters are constant for each species.—L. **Daniel**: Researches on the comparative development of the lettuce in sunlight and in the shade.—H. **Colin**: The utilisation of glucose and lævulose by the higher plants. Analyses are given of total dextrose and lævulose and the ratio of these two hexoses in various parts of the plant in the case of beetroot, Jerusalem artichoke, and chicory.—E. **Esclangon**: The physiological sensations of

detonation.—E. **Bourquelot** and M. **Bridel**: Application of the biochemical method to the study of several species of indigenous orchids. Discovery of a new glucoside, loroglossine. This new glucoside was isolated from *Loroglossum hircinum* in crystalline form. It is hydrolysed by hot dilute sulphuric acid or by emulsin.—A. **Bayet** and A. **Slosse**: Arsenical poisoning in industries involving coal and its derivatives. The study of numerous cases of pitch-cancer in a briquette works showed that many of the symptoms strikingly resembled those of chronic arsenical poisoning. Arsenic was proved to be present in the pitch, in the dust floating in the air at the works, in the hair of all the workmen, and in notable quantities in the urine and blood of the greater number of the workmen. Analyses of the blood, urine, and hair of other workmen, living in the same district, but not employed in briquette-making, gave negative results for arsenic. Thus from both the chemical and the clinical examination the conclusion is drawn that the symptoms observed in workmen handling pitch are those of chronic arsenical poisoning.

BOOKS RECEIVED.

Joseph Priestley. By D. H. Peacock. Pp. 63. (London: S.P.C.K.) 2*s*. net.

The Geology of South Australia. By W. Howchin. In two divisions. Division i., An Introduction to Geology, Physiographical and Structural, from the Australian Standpoint; Division ii., The Geology of South Australia, with Notes on the Chief Geological Systems and Occurrences in the other Australian States. Pp. xvi+543. (Adelaide: The Education Department.)

Inorganic Chemistry. By Prof. J. Walker. Eleventh edition, revised and enlarged. Pp. viii+326. (London: G. Bell and Sons, Ltd.) 5*s*. net.

Elementary Chemistry of Agriculture. By S. A. Woodhead. Pp. vii+188. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

Displacement Interferometry by the Aid of the Achromatic Fringes. By Prof. C. Barus. Pt. iii. Pp. 100. (Washington: The Carnegie Institution of Washington.)

Naval Officers: Their Heredity and Development. By C. B. Davenport, assisted by M. T. Scudder. Pp. iv+236. (Washington: The Carnegie Institution of Washington.)

Duration of the Several Mitotic Stages in the Dividing Root-tip Cells of the Common Onion. By Dr. H. H. Laughlin. Pp. 48+plates. (Washington: The Carnegie Institution of Washington.)

DIARY OF SOCIETIES.

THURSDAY, April 24.

Mathematical Society, at 5.—K. Ananda Rau: (1) Lambert's Series; (2) The Relations between the Convergence of a Series and its Summability by Cesàro's Means.—G. H. Hardy and J. E. Littlewood: A Fauberian Theorem for Lambert's Series.

Institution of Electrical Engineers, at 6.—Major A. C. Fuller: The Fullerphone, and its Application to Military and Civil Telegraphy.

MONDAY, April 28.

Institute of Actuaries, at 5.—P. H. McCormack: Group Insurance.

TUESDAY, April 29.

Royal Institution, at 3.—Prof. Keith: British Ethnology—The People of Wales and Ireland.

Faraday Society and Röntgen Society (Joint Meeting), at 5.—General Discussion: The Examination of Materials by X-Rays. Sir Robert Hadfield: Introduction of Discussion.—Prof. W. H. Bragg: Radio-metallography.—Prof. A. W. Porter: Abstracts of (*a*) Investigation of Metals by means of X-Rays, by F. Janus (Munich) and M. Reppchen (Cologne), (*b*) The Principles Governing the Penetration of Metals by X-Rays, by Dr. G. Respondek (Helensee).—M. H. Pilon and G. Pearce: Apparatus used for Radio-metallography.—Capt. R. Knox and Major G. W. C. Kaye: The Examination of Timber by X-Rays.—Sir Robert Hadfield, S. A. Main, and J. Brooksbank: (1) Testing the Absorption Power of Different Steels under the X-Rays. (2) X-Ray Examination as Applied to the Metallurgy of Steel. (3) Radiographic Examination of Carbon Electrodes used in Electric Steel-making Furnaces. (4) A Method of Testing an X-Ray Tube for Definition.—Lt.-Col. C. F. Jenkin: The Detection of Hair Cracks in Steel by means of X-Rays.—F. F. Renwick: The Behaviour of Photographic Plates to X-Rays considered in Relation to the Radiography of Metals.—Dr. R. E. Slade: Contrasts in X-Ray Photographs.—M. E. Schneider (Le Creusot): Radio-metallography.

Zoological Society, at 5.30.—Dr. W. T. Calman: Marine Boring Animals.—Noel Tayler: A Unique Case of Asymmetrical Duplicity in the Chick.—Geo. Jennison: A Chimpanzee in the Open Air in England.

Institution of Civil Engineers, at 5.30.—Annual General Meeting.

WEDNESDAY, April 30.

Royal Aeronautical Society, at 8.—Major H. E. Wimperis: Aerial Navigation.

THURSDAY, May 1.

Royal Institution, at 3.—Dr. H. S. Hele Shaw: Clutches.

Linnean Society, at 5.—J. Small: The Pappus in the Compositæ.—Montagu Drummond: Notes on the Botany of the Palestine Campaign: I. The Flora of a Small Area in Palestine.—H. N. Dixon: Mosses from Deception Island.

Institution of Electrical Engineers, at 6.—Dr. C. Chree: Magnetic Storms.

Chemical Society, at 8.—Prof. J. H. Jeans: The Quantum Theory and New Theories of Atomic Structure.

FRIDAY, May 2.

Royal Institution, at 5.30.—Prof. J. W. Nicholson: Energy Distribution in Spectra.

Institution of Mechanical Engineers, at 6.—Dr. W. H. Hatfield: The Mechanical Properties of Steel, with Some Consideration of the Question of Brittleness.

SATURDAY, May 3.

Royal Institution, at 3.—Prof. H. S. Foxwell: Chapters in the Psychology of Industry.

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THURSDAY, MAY 1, 1919.

THE COMPLETE PHYSICAL CHEMIST.

A System of Physical Chemistry. By Prof. W. C. McC. Lewis. (Text-books of Physical Chemistry.) Second edition. In three volumes. Vol. i., "Kinetic Theory." Pp. xii + 494. Price 15*s.* net. Vol. ii., "Thermodynamics." Pp. vi + 403. Price 15*s.* net. Vol. iii., "Quantum Theory." Pp. viii + 209. Price 7*s.* 6*d.* net. (London: Longmans, Green, and Co., 1918–19.)

A REVIEW of the first edition of Prof. Lewis's book appeared in these columns in September, 1916, and the fact that a second edition has been called for so soon must be very gratifying to the author. Prof. Lewis has taken advantage of the opportunity thus presented him of introducing a few corrections and amendments, and has considerably increased the subject-matter. The principal changes include the insertion of a section on X-rays and crystal structure, large additions to the sections on colloids, catalysis, etc., a new chapter on osmotic pressure, and the expansion of the last chapter of the original vol. ii. into a separate vol. iii., dealing exclusively with the quantum theory. The excisions are remarkably few, and we have only noted one of any importance.

The author's method of treatment of his subject-matter naturally remains unaltered. The more classical portions are presented to the student in much the same manner as in several of the older text-books (and, it might be added, lecture courses). As regards more recent work the author is apparently well aware of his rather obvious lack of the critical faculty, and in the presentation does not emphasise any particular point of view as being his own. This he achieves by giving the results of each piece of work in, so far as possible, "the investigator's actual words." But, whatever we may think of the lack of criticism in the presentation of any particular summary, we must confess that, as a whole, the work included in the survey of each section is usually admirable in its selection. So broad is the field covered by the author that we can scarcely expect a critical and authoritative pronouncement on every separate item.

Considering more closely a few points in vol. i., we should have thought, since the work of Bohr and Moseley has now been embraced in the author's survey (in vol. iii.), that there would be some alterations in the first chapter. The author's sense of values appears at fault when he once again apportions more space to Nicholson's theory of the atom than to the whole subject of radioactivity. There are some parts of the subject, such as those dealing with the nuclear charge and isotopism, the omission of which seems particularly regrettable. As it stands, this small section has scarcely been brought up to the knowledge of the year 1916, far less of 1918, and this is true of other references to the subject, such as that on p. 449, which also seems in urgent need of revision. In the summary of the Braggs' work presented in the second chapter we were struck by the consistent use of the sequence (y, x, z) instead of the customary (x, y, z) in the naming of intercepts, and by the referring to the sodium chloride space lattice as face-centred, while what is meant is face-centred relative to one kind of atom. In chap iii. we once again encounter "the more convenient logarithmic form $\Sigma\nu \log C = K$" instead of the usual $\log K$. On p. 197 the last column in the first table is still uncorrected. Prof. Lewis apparently now regards methyl-orange as "essentially a basic indicator," and in consequence inserts as a correction the word *basic* on p. 256, with the result that we are informed that, since methyl-orange is neutral-coloured in a 10^{-4} $H^{\cdot}$ solution, "its (basic) dissociation constant lies in the neighbourhood of 10^{-4}." This should evidently be 10^{-10}. On p. 440 the author introduces as a new term "the *displacement* effect." In view of the use that has already been made of the defining word in Wien's *displacement law*, the term is not too happily chosen, and "*replacement* effect" is perhaps as suitable a descriptive term.

Turning to vol. ii., we find that a great portion consists in the presentation, with the aid of thermodynamics, of matter which has already been partly discussed in vol. i. Whether this separation is altogether desirable is an arguable point. To select an example at random, we confess we are unable to see the virtue in giving in vol. i. a table of the temperature variation of a mass action constant, while the theory of the variation is given in vol. ii. Again, in the new chap. viii., "the *mechanism* of osmotic pressure" might have seemed more in place in the first volume, which deals with the kinetic point of view. As it is, of course, it fits in quite well. In the addition at the end of chap. i., in speaking of the vapour pressure in a column, the author remarks: "the pressure at the top being *entirely* due to the kinetic bombardment by the molecules." But surely it could be argued that the pressure at the foot is also *entirely* due to the kinetic bombardment by the molecules, even if it is greater than the pressure at the top by the weight of the column per unit area. We note that the author has now adopted "S" in place of "ϕ" as the symbol for entropy. In his brief reference to the entropy equation of a perfect gas there is no adequate discussion of C_v, and the evasion of the lower limits of the integral is not too adroit. A symbol, by the way, is omitted in the first equation on p. 46. The footnote on p. 100 to the effect that "thermodynamic reversibility has, of course, nothing to do with reversibility in the chemical or mass action sense" seems open to question. On p. 140 the author is evidently unable or unwilling to decide against Planck, though Planck has undoubtedly slipped. As regards the footnote on p. 142, there is a laboratory method of measuring e.m.f. which does *not* involve the use of a potentiometer.

K

The third volume presents in an easily accessible form the most important theoretical and practical work on the quantum hypothesis, embracing much that is not included in Jeans's report. We have noted one awkward slip, a "howler" on p. 27 in the proof that the central force is equal to mv^2/ρ. The angle between tangent and secant is made equal to the angle *at the centre*, and then by an abuse of infinitesimal geometry the correct answer is obtained. In chap. v., on the structure of the atom, we are surprised to find Moseley's work dismissed in less than a page, the same space nevertheless being allocated to Allen's empirical relation, while Barkla is not mentioned. There is a misprint in the second formula on p. 115. We sincerely deprecate the habit of bestowing double-barrelled names on equations save when there is clear evidence of independent discovery. From the text-book it would appear that the "Marcelin-Rice" equation (p. 139) was discovered by Marcelin, and the method of deduction improved by Rice. If this is the case the second name should be dropped from the equation. We should have liked to see the appendices (of which i. and ii. are by J. Rice) incorporated in the text.

We have confined our attention almost entirely to the additions and alterations made by the author in his new edition. If we have emphasised the defects rather than the excellences of his work, we must plead that we are seeking to help him in the presentation of the only complete system of physical chemistry by an English-speaking author. We have no hesitation in saying that we regard these volumes as absolutely indispensable books of reference to every advanced worker in physical chemistry and chemical physics, though it is unfortunate from the point of view of a standard text-book that the author's treatment of the newer portions of his subject will compel him to make frequent changes in subsequent editions. A. M. W.

ACIDOSIS.

The Principles of Acidosis and Clinical Methods for its Study. By A. Watson Sellards. Pp. vi+117. (Cambridge, Mass.: Harvard University Press, 1917.) Price 4*s*. net.

ACIDOSIS may be defined as a condition in which there is a diminution in the normal slight alkalinity of the blood or tissues of a living organism; and a real or supposed state of acidosis has come in recent times to play a leading part in the explanation of many abnormal symptoms, including in particular a number of those which have been produced in the course of the war. The whole subject is thus one of considerable present scientific interest, and for this reason Dr. Sellards's book on the principles of acidosis is specially welcome.

The fact that in the living body the faintly alkaline reaction of the blood and tissues is regulated in a remarkable manner has been known for long. The non-volatile acid or alkali produced within, or introduced into, the body varies considerably, according to the composition of the food; and in man acid predominates, mainly on account of the fact that the alkali contained in the food is not sufficient to neutralise the sulphuric and phosphoric acids produced in the oxidation of proteins. The excess of inorganic acid is partly got rid of by the secretion of an acid urine, and partly neutralised by the formation of ammonia; while organic acids introduced into or formed within the body are for the most part oxidised along with other organic materials, the resulting carbonic acid being got rid of in respiration. It is only in recent years, however, that it has been shown that the concentration of free carbonic acid in the blood is regulated by the breathing with extreme delicacy, and that the breathing is itself normally regulated by the very minute changes in hydrogen-ion concentration produced by variations in the concentration of free carbonic acid in the blood, or by variations in its hydrogen-ion concentration from other causes.

The lungs thus constitute a safety valve which acts more freely or less freely according as the hydrogen-ion concentration of the blood increases or diminishes. We can correlate the variation in respiratory activity, first, with the variations in concentration of CO_2 in the air of the lung alveoli, and consequently of the free carbonic acid in the arterial blood; secondly, with the corresponding variations in hydrogen-ion concentration of the arterial blood. The result of this correlation has been to show that the regulation of hydrogen-ion concentration in the blood of man is so delicate that existing methods of measurement are far too coarse to reveal the changes in reaction to which the breathing reacts, unless where there are very great variations in the breathing. Thus with the existing methods of measurement the hydrogen-ion concentration of the blood appears to be constant; and where apparent distinct variations have been found they have nearly always been due to faulty methods of measurement. Minute variations in hydrogen-ion concentration are constantly occurring, as shown by variations in the breathing, but, as a rule, they are too small to be directly measurable by existing methods. There is also evidence that extremely small variations in hydrogen-ion concentration are of very great physiological importance.

Unfortunately, these considerations have not as yet been fully realised by medical men, or by more than a few physiologists, and the result is a veritable pandemonium of doctrine and practice in connection with real or supposed acidosis and its treatment. Dr. Sellards's book is not free from the prevailing confusion, as he seriously misinterprets the connection between breathing and the hydrogen-ion concentration of the blood. His book is, nevertheless, valuable and very well written. He rightly lays stress on the fact that, except in the extremest cases, accurate measurements show no variations in the hydrogen-ion concentration of the blood. But he proceeds to conclude that no variations exist even in what

he regards as quite well-marked "acidosis." He defines acidosis, not as a state in which the hydrogen-ion concentration of the blood and tissues is abnormally increased, but as one in which the reserve of fixed alkali in the body is depleted. This depletion is shown by the fact that, whereas in a normal individual it only requires a small dose of sodium bicarbonate to make the urine alkaline, it requires a very large dose in the case of a patient suffering from acidosis.

The evidence which Dr. Sellards adduces to illustrate the soundness of this test for acidosis is very interesting and, in the main, new. Much of this evidence is from observations which he made in the Philippines in treating kidney inflammation in cholera. Acidosis may be due to abnormal flooding of the body with organic acids, as in diabetic coma, or to failure on the part of the kidneys to excrete acid, as in kidney inflammation. In either case the test proposed by Dr. Sellards indicates the condition. But the whole subject becomes much clearer if it is recognised that in serious acidosis there is an actual increase in the hydrogen-ion concentration of the blood, and that of this increase the increased breathing is by far the most direct sign. It appears to be the untrustworthiness of direct means of measuring small differences in hydrogen-ion concentration that has led some writers in this country to deny that dangerous acidosis exists at all in such conditions as diabetic coma or kidney disease, although both the greatly increased breathing and the favourable effect on the symptoms of large doses of sodium bicarbonate indicate the existence of what is, physiologically speaking, an extreme state of acidosis.

The confusion is rendered still greater by failure to distinguish primary acidosis due to flooding of the body with acid from the secondary acidosis which is an adaptive physiological response to lack of oxygen, and leads to increased ventilation of the lungs and, consequently, increased supply of oxygen to the blood. This form of acidosis is met with typically at high altitudes and in various conditions, such as poisoning by irritant gases, where the free supply of oxygen to the body is interfered with. Here the acidosis is brought about by diminution in the amount of fixed alkali or "alkaline reserve" in the blood, with the result that the breathing is increased. There is no directly measurable increase in hydrogen-ion concentration of the blood, nor, in view of what has already been said, could this be expected; but the increased breathing is, nevertheless, good evidence of the existence of an increase. The diminution in alkaline reserve in the blood is easily detected, either by titration or by a diminution in the capacity of the blood for combining with CO_2; and the latter method, particularly in the form given to it by Van Slyke, has been extensively used during the last year or two. The acidosis detected in this indirect way has, however, frequently been interpreted as in itself a symptom to be combated by alkalis, when it is in reality an advantageous compensatory reaction. Fortunately, the body can usually dispose of even large quantities of alkaline medicaments administered through this misunderstanding. Dr. Sellards's test for acidosis would exclude a compensatory acidosis, but would also lead to a compensatory acidosis being missed, and perhaps, as a consequence, to the cause of the compensatory acidosis being overlooked.

To interpret the significance of increased breathing, diminished alkaline reserve in the blood, or any of the other symptoms which usually accompany acidosis, it is necessary to take the whole of any existing abnormal physiological conditions into account, just as in interpreting the significance of any one of the usual physical signs of disease it is necessary to consider the whole of the symptoms and their course. The confusion which exists at present on the subject of acidosis is largely due to neglect of this principle. Perhaps this confusion is rendered most evident by the quite recent discovery by Yandell Henderson that when an animal is dying of "alkalosis," produced by withdrawing carbonic acid from the body by excessive artificial respiration, the alkaline reserve in the blood is greatly diminished in a physiological effort of the body to preserve the normal reaction; and, conversely, that when an animal is suffering from extreme acidosis owing to a great excess of CO_2 in the inspired air, the alkaline reserve of the blood is greatly increased in a corresponding compensatory effort. A diminution in alkaline reserve of the blood is thus not by itself a certain index of acidosis, or of whether or not an acidosis, if it exists, is harmful.

J. S. Haldane.

TROPISMS.

Forced Movements, Tropisms, and Animal Conduct. By Prof. Jacques Loeb. Pp. 209. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 10*s.* 6*d.* net.

A PROLIFIC investigator does a great service to his brethren when, without waiting to write an elaborate treatise, he collects the gist of some considerable portion of his work into a book; and if the book be a small one, so much the better. This Prof. Loeb has now done, and we are immensely obliged to him. What is more, his volume is but the first of a series, by American writers, all dealing with the wide field of experimental biology, a field in which we at home have done comparatively little, but in which American biologists have greatly distinguished themselves. Among the promised monographs are one by Prof. Morgan on "Chromosomes and Heredity"; another, by Dr. Jennings, on "Pure Line Inheritance"; a third, by Dr. T. B. Robertson, on "The Chemical Basis of Growth"; and a fourth, by Prof. Osterhout, on "Permeability and Conductivity of Living Tissues." In every case (and there are many more besides these) the author has won, and more than won, his right to be heard, and in every case also we feel the need of an authoritative guide to the subject in question.

Prof. Loeb is an out-and-out "mechanist," as we all know. He is impatient (as he tells us in the first words of his preface) with "the attempts of vitalists to show the inadequacy of physical laws for the explanation of life." He insists on the "quantitative methods of the physicist," and will have nothing to say to the romantic, or anthropomorphic, tales of "scientific popularism." His book begins with an account of the symmetry of the organism, as the starting-point for his theories of conduct; that is to say, he finds in the existence of bodily symmetry, whether radial or bilateral, a simplification of all further analysis. The symmetry is a dynamical as well as a morphological one; there is a symmetry which corresponds with the impulses from without, as to the reactions from within; muscular system and nervous system have their own corresponding symmetries, and the whole problem of action and reaction is simplified thereby. But it does not follow that all animals are symmetrical—at least, in this simple fashion. The spiral Euglena, for instance, is a harder case; and the experimentalist may convert the symmetrical into an unsymmetrical animal, as when he destroys one hemisphere of a dog's brain, or makes a beetle blind of one eye. The "reflex actions" of the physiologist are the reactions of parts, or isolated segments; a similar or analogous reaction of the whole is likewise assumed to be, or may be interpreted as, a phenomenon of a purely physicochemical nature. And these reactions of the whole organism are what Prof. Loeb calls "tropisms."

Through such reactions, or tropisms, Prof. Loeb leads us, in connection with the various stimuli of light, heat, electricity, chemical action, gravity, contact, and so forth, and at last comes face to face with the more recondite themes of instinct and memory. Let us consider a single experiment out of the great number which this small book relates. Many animals, very humble ones included, tend to move towards the light, while some, on the other hand, retire into the darkness or the shade; some love the light, and some hate and avoid it, as we are apt, in our anthropomorphic fashion, to say. Suppose, now, that we illuminate the two eyes of a fly by separate beams of light, of equal intensity and similarly directed. The fly will not choose between the two lights, says Prof. Loeb, as a belated traveller might choose between the lights of two village inns; it will do something much simpler, and apparently more mechanical. It will travel straight along a line perpendicular to that which joins the two lights; it will follow the resultant of the two stimuli. Not only so, but if we alter the direction of the beams, or cause them to differ in intensity, so that in either case one eye receives more illumination, more "phototropic stimulus," than the other, then the creature will move along a perfectly definite line, which can still be simply calculated as the resultant of the two forces involved. The experiment is an ingenious and an elegant one, and, without for a moment doubting the results which Prof. Loeb and his pupils have repeatedly obtained, we can honestly say that we should dearly like to see it performed.

We dare not attempt to discuss the great philosophic questions that are involved in the whole course of these experiments. We have a notion that "anthropomorphism" is not got rid of quite so easily, however much we change our phraseology, as Prof. Loeb would have us believe, and that, great as are the lessons of mechanics, they do not tell the whole story, after all. Be that as it may, the element of precision, the quantitative element, the strict, experimental method, is conspicuous in Prof. Loeb's work, and our knowledge is manifestly increased thereby. I think it was Liebig who said, in one of his letters to Faraday, that (in those days) a man might be an eminent geologist in England who knew nothing of physics, nothing of chemistry, nothing even of mineralogy. Change the wording, and the biologist may (or once upon a time might) have begun to feel uneasy. It is something to be taught or reminded by Prof. Loeb, and by the whole brotherhood of experimental biologists, that the naturalist cannot live alone, but works in a field inextricably connected, for better for worse, with the whole range of the physical sciences.

Prof. Loeb has a boundless wealth of ideas. In this book and in his other books and papers we seem to see them tumbling one over another. He has enough and to spare for all his pupils and fellow-workers, so that all who come to him may eat and be filled. Moreover, his manifold experiments all have the hall-mark of simplicity, and this is surely one of the greatest things that can be said of any experimenter. There is no parade of elaborate apparatus, nor does it ever seem to be required. *Simplex sigillum veri!*

The book concludes with a bibliographical list of nearly six hundred titles—a catalogue of books and papers on experimental biology, in the sense in which Prof. Loeb himself deals with it. In the first hundred and fifty titles (and I have gone no further in my analysis) sixty-three are German, forty-three American, thirty-eight French, and four more are Dutch or Italian. I shrink from doing the addition and subtraction which would reveal our British share.

D'ARCY W. THOMPSON.

OUR BOOKSHELF.

The Strawberry in North America. History, Origin, Botany, and Breeding. By Prof. S. W. Fletcher. Pp. xiv+234. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 8s. net.

WITH marked success Prof. Fletcher has gathered into a comprehensive survey much information of great interest in the history and development of the strawberry. Though the book is primarily written for American readers, it appeals to the English gardener and student of horticulture, as English varieties and methods of cultivation had a strong influence on the improvement of the fruit in North America. Garden cultivation began

about 1700, but growing for market purposes was not seriously taken up for another century, after which the need for improved varieties soon arose. A new era was ushered in in 1834 by the introduction of the Hovey strawberry, which was the first named variety to be produced by definite plant breeding in North America. From this time the development of commercial cultivation was rapid, and it was accentuated by the competition due to increased facilities for transporting the fragile berries over longer distances. The tenderness of the fruit necessitated a search for the ideal package for marketing, and many descriptions of punnets, boxes, tubs, and trays have been exploited.

The survey includes an outline of observations and experiments on the crossing of species and the raising of new varieties. The illustrated account of present-day methods of breeding and selection gives a useful summary of the subject, and the sketches of abnormal freak berries are of interest to the morphologist. The biographical notices in the last chapter form a fitting conclusion to the book by directing attention to the men to whose careful and patient work is due the great improvement in the strawberry in North America.

The Journal of the Institute of Metals. No. 2. 1918. Vol. xx. Edited by G. Shaw Scott, secretary. Pp. xi + 382. (London: Published by the Institute of Metals, 1918.) Price 21*s.* net.

THE twentieth volume of this valuable publication contains a variety of papers of scientific and technical interest. The May lecture, by Sir Charles Parsons, describes the experiments on the artificial production of diamond made by the lecturer during the last thirty years, and discusses the bearing of the results obtained on the problem of the origin of natural diamonds. A group of papers deals with the grain growth of metals, Dr. Zay Jeffries giving a review of the whole subject, and making much use of experiments with tungsten filaments. The observations are by no means easy to interpret, and some of the conclusions appear to contradict one another; but the author has made a most important contribution to a subject of great interest, and it may be possible shortly to bring the facts into harmony. Mr. D. Hanson, in a short note, describes experiments on the same problem, discussing the relation between the rapidity of grain growth at a given temperature and the amount of deformation to which the material has been previously subjected.

A third paper, by Mr. R. J. Anderson, describes the effect of short exposures to various temperatures on cold-rolled aluminium sheet, and although it is the hardness in this case, and not the grain size, which is measured, the phenomena involved are essentially similar to those discussed in the preceding papers. Prof. Edwards gives an account of the method of determining hardness by measuring the resistance to penetration under impact, and there are several contributions on the subject of commercial copper alloys. An interesting communication by Mr. W. E. Alkins records the effect of progressive cold work on the tensile properties of copper wire, an abrupt change being observed at a certain stage in the reduction of cross-section by drawing. The allotropic change assumed by the author requires more evidence before it can be accepted as an explanation, but the facts are remarkable, and must be taken into account in future work. The volume includes the usual abstracts of publications referring to the non-ferrous metals. C. H. D.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Doppler Effect in the Molecular Scattering of Radiation.

IN connection with the recent work of Prof. Strutt and of Lord Rayleigh on the molecular scattering of light, Sir Joseph Larmor has put forward the interesting suggestion (*Phil. Mag.*, January, 1919, p. 162) that the additive property of the energy elements scattered by the individual molecules is secured by the irregular alterations in the wave-length of the scattered radiation produced (in accordance with Doppler's principle) by the thermal movements of the molecules. There is one interesting feature of the Doppler effect in the scattered radiation to which Sir Joseph Larmor does not specifically direct attention in his paper, and which it seems important to emphasise, namely, that the magnitude of the Doppler effect would depend on the *angle* between the primary and the scattered radiation, and would, in fact, practically vanish in directions nearly the same as that of the primary waves. This follows from the fact that the movement of an individual molecule would alter the effective frequency of the radiation *received* by it, and this has to be taken into account in calculating the effective frequency of the *emitted* radiation as received by the observer. In directions nearly the same as that of the primary radiation there would be practically a complete compensation, and the Doppler effect would vanish.

The importance of the considerations set out above becomes evident when we attempt to explain refractivity on the basis of molecular scattering. This appears possible only if the energy effects due to the individual molecules are *not* additive in directions nearly the same as that of the primary wave, and the vanishing of the Doppler effect in the scattered radiation would seem to be a necessary condition for mutual interference of the radiations from individual molecules to be possible. C. V. RAMAN.

210 Bowbazar Street, Calcutta, March 19.

THE point developed in a new direction by Prof. Raman had been noted by Lord Rayleigh, and was mentioned very cursorily in the last sentence of my paper in the *Phil. Mag.* to which his letter refers. The main purpose of that paper was to express the view that, so far as I understand, independent scattering of light by the molecules of a homogeneous

medium, so dense that there are very many molecules per cubic wave-length—for example, in the atmosphere—must arise from the thermal motions of the molecules rather than from irregularity of their spacing. In directions, however, that are nearly coincident with the transmitted ray there can be no sensible dispersal of phase from either cause; disturbances, therefore, completely conspire, and the light scattered by the molecules in such directions is, in Lord Rayleigh's phrase, specially favoured. Prof. Raman points out that if the phases in directions near that of the ray did not in fact thus agree, the molecules of the material medium could take no concordant part in the transmission of the energy of the main beam, and regular propagation would be impossible. It is involved in this remark that each molecule will exert its full effect on the index of refraction, however irregular the distribution may be, provided it is not so dense that the molecules will obstruct each other; and, moreover, the thermal motions will not disturb this effect. The specially favoured directions, for disturbances passed on by the molecules, must be almost coincident with the ray—must, in fact, belong to the ray after the manner of diffraction, when it is regarded as a physical filament of light rather than as a geometrical line.

The light that may be scattered in a crystal must, on any view, be due either to motes embedded in it or to the thermal motions of its molecules around their regularly spaced mean positions. A beautiful recent experiment by Prof. Strutt, now reported in the Proceedings of the Royal Society, exhibits a spiral beam scattered sideways when plane-polarised light passes through a column of quartz; thus, incidentally, it puts in direct visual evidence the slow rotation of the plane of polarisation of the vibrations which arises from the spiral structure of the crystal.

JOSEPH LARMOR.

Cambridge, April 24.

INDIAN ASTRONOMICAL INSTRUMENTS.[1]

INDIAN astronomy, handed down to us in a series of text-books, the *Siddhântas*, of which the earliest dates from about A.D. 400, is an offspring of Greek astronomy. *Via* Babylon and the Greek kingdom of Bactria (the Kabul valley and the Punjab), Greek science was introduced into India in the course of the two or three centuries following the invasion of Alexander the Great. While, during the Middle Ages, many astronomers in western Asia and North Africa did good work by re-determining astronomical constants and improving planetary tables by new observations, no attempts whatever in this direction were made in India. It is therefore very curious to find that an extremely belated effort to revive the study of astronomy, and at last to try to advance this science by independent work, was made early in the eighteenth century in the north of India.

FIG. 1.—General view, Jaipur Observatory. From "The Astronomical Observatories of Jai Singh."

Rajah Jai Singh of Jaipur (born 1686, died 1743) was interested in astronomy from his youth. He wrote or caused to be written an astronomical work named after the Emperor Muhammad Shah, of which there are now extant an imperfect copy in Sanskrit (at Jaipur), and a complete MS. in Persian in the British Museum. It contains a star catalogue, which, however, is nothing but the catalogue of Ulugh Beg, with 4° 8′ added to the longitudes to allow for precession. A translation of the introduction was published by Hunter in the "Asiatic Researches," vol. v. (1799); it is

[1] "The Astronomical Observatories of Jai Singh." By G. R. Kaye. (Archæological Survey of India, New Imperial Series, vol. xl.) Pp. viii+151+26 plates+1 map. (Calcutta, 1918.) Price 23s.

reproduced by Mr. Kaye in the valuable book now under notice. In this introduction Hipparchus is referred to as an ignorant clown, and Ptolemy as a bat who can never arrive at the sun of truth; the demonstrations of Euclid are said to be an imperfect sketch, and "the European tables" to be often in error. Jai Singh therefore decided to erect new instruments of colossal size, similar to those made by Ulugh Beg at Samarkand in the fifteenth century. Among the latter we know from other sources that there was a quadrant of 180-ft. radius, while a 60-ft. sextant is said to have been erected at Baghdad in A.D. 992. Before the application of diagonal scales or verniers to graduated arcs there was only one way of making single minutes and fractions of them distinguishable—by enlarging the instruments as much as possible. Jai Singh first constructed a number of astrolabes of iron or brass, from 6 in. to 7 ft. in diameter, many of which are still preserved at Jaipur. In four plates Mr. Kaye gives sixteen photographic illustrations of these astrolabes, but most of them are too indistinct to show details.

Jai Singh's chief work, however, was the building of masonry instruments, ranging from a few feet to 90 ft. in height, at Delhi, Jaipur, Ujjain, Benares, and Mathura. They have often been described in a more or less sketchy manner in books on India; but Mr. Kaye gives an exhaustive account of them, beautifully illustrated by a number of plates.[2] They are really nothing but gigantic sun-dials. Thus the *Samrāt Yantra*, or "supreme instrument," consists of a gnomon in the form of a rectangular triangle with the hypotenuse parallel to the earth's axis, and an equatorial arc on either side. The two largest examples are at Delhi (height 68 ft., radius of arcs 49½ ft.) and at Jaipur (90 ft. and 50 ft.) (Fig. 1). The *Jai Prakas* is a hemispherical bowl, on the concave surface of which are marked the equator, meridian, and other circles, on which the shadows of wires might fall. The *Ram Yantra* (Fig. 2) is a cylindrical wall with a vertical pillar in the middle. Neither these nor any of the other instruments show any originality of design. The best known of these five collections of masonry instruments is probably the Delhi Observatory, called the Jantar Mantar, built about 1724, 3½ miles south of the Ridge, so that it will be a notable feature in the new capital. It contains six instruments. The graduations on the gnomon of the *Samrāt Yantra* are scratched into the lime-plaster surface, but those of the quadrants are well marked with a soft, black stone neatly inlaid into the face of the arcs. This seems, however, to be the result only of a restoration carried out in 1910–12. At Jaipur the instruments are well preserved, being within the precincts of the palace. At Benares the instruments were erected in 1737 on the roof of a building; they are therefore of moderate size. A much-needed restoration took place in 1912. At Ujjain the four instruments are in a state of ruin, and those at Mathura have quite disappeared.

There is no record of any attempts having been

FIG. 2.—The Ram Yantra, Delhi, North Building. From "The Astronomical Observatories of Jai Singh."

[2] There are a number of tiny models of them in the South Kensington Museum.

made to do systematic work with these instruments, nor would it have been of the slightest use to employ them for anything but lecture-demonstrations. In 1728 or 1729 Jai Singh sent Figueredo, a Portuguese Jesuit, to Europe to procure astronomical tables, and he brought back "tables published under the name 'Lir,'" *i.e.* the tables of La Hire. Mr. Kaye also thinks that Jai Singh possessed the "Historia Cœlestis" of Flamsteed, and says (p. 69) that "he must have been acquainted with the teaching of Kepler, Galileo, and Newton, for he possessed the works of La Hire, Flamsteed, and others." But neither of these works could give the slightest clue to the teaching of European astronomers. The "Historia Cœlestis" contains Flamsteed's observations and the resulting star-catalogue (as well as reprints of previous catalogues), and La Hire's planetary tables are not founded on any theory, but were constructed in an empirical manner, as to the details of which nothing is known. Mr. Kaye suggests (p. 90) that as Jai Singh's European advisers were chiefly Roman Catholic priests, the development of astronomy since Copernicus must have been discredited in his eyes. This suggestion is of course quite unwarranted, as there were plenty of priests in those days who did good work in astronomy.

J. L. E. DREYER.

THE OCCLUSION OF GASES BY METALS.

PRESIDING at the meeting of the Faraday Society in November last, at which the subject of the occlusion of gases by metals was discussed, Sir Robert Hadfield delivered an introductory address, which is about to be published by the society with an account of the discussion. It appears from the bibliography attached to this address that Thomas Graham was one of the first to investigate this subject. His results were published in the Philosophical Transactions of the Royal Society in 1867, the title of the paper being "The Occlusion of Gases by Meteoric Iron." The particular specimen investigated contained 90·9 per cent. of iron, 8·45 per cent. of nickel, and a small quantity of cobalt. It was free from any stony admixture, and was remarkably pure and malleable. A strip cut from this with a clean chisel was first well washed with a hot solution of potash, then with distilled water, and afterwards dried. It was then placed in a porcelain tube which was evacuated and afterwards heated to redness in a combustion furnace.

Gas was observed to come off freely, and was collected in successive portions. The first portion evolved consisted principally of hydrogen. Succeeding portions also contained hydrogen as the chief constituent, with smaller quantities of carbonic oxide and nitrogen. This particular specimen of iron yielded 2·8 times its own volume of gas. Graham also investigated the gas taken up by iron from a carbonaceous fire, and in the case of some clean horseshoe nails which he heated in a similar way he found that the metal yielded 2·66 times its own volume of gas, containing about 50 per cent. of carbonic oxide, 35 per cent. of hydrogen, 7·7 per cent. of carbon dioxide, and 7 per cent. of nitrogen. He concluded that as hydrogen was recognised in the spectrum analysis of the lights of the fixed stars, the Lenarto meteoric iron which he had investigated came from an atmosphere in which hydrogen was the chief constituent, and that it held imprisoned within it the hydrogen of the stars.

The latest investigations on the subject of "Occluded Gases in Ferrous Alloys" are those by Allemann and Darlington, whose results are published in the proceedings of the Franklin Institute of Philadelphia in February, March, and April of 1918. These investigators describe a gas-tight vacuum furnace which they have constructed capable of continuous service at temperatures of approximately 1900° C. By means of this they claim that all the gases occluded by ferrous alloys may be removed and collected. They have found that hydrogen is most readily set free, that carbon monoxide comes next, and that nitrogen appears to be held the most tenaciously. As yet they have been unable to determine whether the presence of oxygen in their gases is due to the decomposition of the various oxides of iron or the dissociation of one of the oxides of carbon. Allemann and Darlington have found that ferrous alloys may occlude relatively large volumes of gases, in some cases equal to 200 times the volume of the metal, and they suggest that, in addition to the ordinary functions of metals, aluminium, silicon, manganese, titanium, and tungsten, when added to molten iron alloys, may either prevent the occlusion of large quantities of gases or aid in eliminating such gases at lower temperatures than those at which such elimination ordinarily occurs. Finally, they have shown that the removal of these gases markedly changes the microstructure and increases the density of the alloys.

Sir Robert Hadfield then proceeds to consider the bearing of scientific work of the foregoing kind on the problem of obtaining sound steel, and quotes at some length the views of the late Dr. Héroult as set forth in his paper on "The Presence and Influences of Gases in Steel." Héroult pointed out that the gases obtained from blowholes in unsound steel ingots always contain hydrogen and nitrogen, often with only traces of carbon monoxide, but it is well known that sound steel, when heated *in vacuo*, also gives off these gases. It has also been shown that the quantities of gases so liberated are about the same, whether the steel be made by the crucible, the Bessemer, the open hearth, or the electric furnace. In consequence of this he concluded that hydrogen and nitrogen are not the cause of the production of blowholes, but that the latter are the result of the liberation of carbon monoxide, except in the case of blowholes near the surface, which are due to the poor condition of the moulds. Héroult's view of the production of blowholes was as follows:—

The carbon monoxide does not pre-exist in the

steel. It is produced only when the latter cools down and has partly solidified. Steel that will produce blowholes contains in the molten condition dissolved carbon and oxygen, and for each temperature and composition there is a particular equilibrium at which no chemical reaction takes place. The heat is then what is called "dead-melted." If, on one hand, the temperature is raised, the reducing action of the carbon is intensified, and carbon monoxide will be evolved; if, on the other, the temperature is lowered, nothing happens until the steel has partially solidified. This causes an increased concentration of carbon and oxygen in the still liquid portion, as a result of which carbon monoxide is evolved. This gas is unable to escape, and by its pressure produces the blowholes. On cooling, it is gradually absorbed by the now solid metal.

As yet almost nothing is known as to the condition in which these gases exist in metals and alloys. Prof. McBain pointed out in his contribution to the discussion that the occlusion of gases by metals comprises processes which are special instances of the general group of different phenomena known collectively as "sorption," and that in the vast majority of cases the intermingling phenomena have not been disentangled or even experimentally identified. It is necessary to take into consideration true adsorption (surface condensation), true absorption (true solution in a solid), and chemical reactions that may ensue.

Sir Robert Hadfield finally considers briefly the methods which have been found effective in producing sound steel. As he points out, great difficulties were experienced in the early days of making steel castings in producing sound metal. The very useful element silicon was scarcely obtainable except in combinations which caused as much trouble as the unsoundness itself. High-percentage ferro-silicons with low carbon and silico-speigels were unknown. Manganese, though useful, was only a partial cure, and aluminium as a commercial metal had not yet arrived.

It appears that it was three French metallurgists who introduced and perfected the successful production of ferro-alloys containing high percentages of silicon and also manganese, as a result of which the manufacture of sound steel by commercial processes on a large scale was rendered possible. These men were MM. Euverte, Pourcel, and Gautier, of the Terre Noire Works. Credit should also be given to Hall in America and Héroult in France, who were the pioneers of the production of aluminium on a commercial scale. This element is now one of the most valuable available for the prevention of blowholes in steel. As an instance of the successful production of sound steel castings at the present day Sir Robert Hadfield gives some details of the casting of hydraulic cylinders for cotton baling presses. These cylinders have no mechanical work done upon them, but are used in the cast state. They may run up to a length of 30 ft. The ram measures from 7 in. to 9 in. in diameter. The walls of the cylinders seldom exceed $2\frac{1}{2}$ in. in thickness, and have to stand the hydraulic test pressure of 4 tons per sq. in. The steel is cast at a temperature of about 1540° C., and is poured into sand moulds which are liable to give off gases. Its contraction is slightly more than 0·25 in. per ft., so that the mould is not less than 7 in. longer than the cylinder itself when cooled down. Below 1500° C. the steel quickly loses its fluidity, and not many degrees lower it is quite pasty. The fact that, in spite of the difficulty of meeting these conditions, satisfactory cylinders can be made indicates that the art of steel casting has reached a high stage of technical perfection.

H. C. H. C.

PROF. J. J. T. SCHLŒSING.

AGRICULTURAL investigators in all countries will learn with regret of the death of Prof. Jean Jacques Théophile Schlœsing at Paris on February 8. Although Prof. Schlœsing had attained the advanced age of ninety-four, his vigour and mental alertness were unusually good, and he had had the satisfaction of seeing his son continuing in his own branch of science, doing work of great importance, and making a reputation scarcely less distinguished than his own.

Schlœsing was born at Marseilles on July 9, 1824; he entered the Polytechnic in 1841, and was appointed director of the Ecole des Tabacs in 1846. There he began an important series of analytical investigations the purpose of which was to improve the method of detecting and estimating the common constituents of soils and plants, such as potassium, ammonium, nitric, phosphoric, and hydrochloric acids, and the common organic acids, such as acetic, tartaric, citric, oxalic, malic, and others. The current methods of dealing with natural products were sometimes exceedingly laborious, and lacked even the merit of accuracy; the determinations of ammonia in rain-water made with all possible care by Lawes and Gilbert in 1853 had involved the distillation of 2 cwt. of rain and evaporation of the distillate with sulphuric acid; even then the results came out something like 100 per cent. too high. It is impossible, therefore, to over-estimate the value of careful analytical investigations such as those made by Schlœsing.

His next important series of investigations was on the soil. By a lengthy washing process he obtained a preparation of the finest clay particles which remained indefinitely suspended in pure water, but could be precipitated by traces of a calcium or magnesium salt. This was commonly regarded as being in some sense the essential clay, and agricultural chemists marvelled at the minute amount present even in heavy soils. The conception served a useful purpose, but it has now been replaced by a broader one: the soil is now considered to be made up of particles varying from 1 mm. downwards to molecular dimensions, the different groups merging one into another without perceptible breaks. The clay group is assigned for convenience an upper limit of 0·002 mm., but this is regarded as purely conventional.

Another important investigation had to do with the movements of lime in the soil. The conditions of solubility were determined, and deductions were drawn which threw important light on the practices of liming and marling, and on the presence of lime in natural waters.

Further, Schlœsing studied the effect on plant growth of the carbon dioxide and ammonia present in the atmosphere, in the soil, and in natural waters. He set up the well-known hypothesis that the proportion of carbon dioxide in the atmosphere is related to the extent of dissociation of the bicarbonates in the sea. The sea was thus regarded as a reservoir which equalises the stock of carbon dioxide in the atmosphere, taking up any excess that might be formed at any time, and supplying any deficit from the average amount should such ever arise.

Schlœsing's best-known work, however, was on nitrification. For a long time it had been known that nitrates are gradually formed when plant or animal residues, farmyard manure, etc., are incorporated in the soil. The process was of much technical importance in the seventeenth and eighteenth centuries as the source of nitrate for gunpowder. During the Thirty Years' War and other great Continental wars the various Governments had been seriously concerned in these so-called nitre beds, and had done a good deal to stimulate their development. The conditions of the change were tolerably well ascertained, but nothing was known as to its mechanism.

It has several times happened in the history of civilisation that agriculture has benefited by knowledge gained during war. The mass of information accumulated during the eighteenth-century wars, and apparently rendered useless in the nineteenth century by the promise of peace and the discovery of nitrates in Chile, was found to be of fundamental importance in agriculture. It was found that the nutrition of plants so far as nitrogen was concerned depended on the nitre-bed processes; organic nitrogen compounds, useless as plant nutrients, when added to the soil became converted into highly valuable nitrates; the more rapidly this change could be brought about, the better for the plant. So long as the mechanism of the change was unknown, the old knowledge was simply empirical and incapable of full utilisation. Many investigations were therefore made, but for years the problem remained unsolved. The balance of opinion was in favour of a purely physical process, but there was also a strongly supported chemical hypothesis.

Schlœsing and Muntz had been working at the formation of nitrates in sewage during the process of nitrification, and they noticed an inert period of twenty days before the commencement of nitrification. With characteristic shrewdness they observed that this delay could scarcely arise if the process were purely physical or chemical; some biological factor seemed to be indicated. In order to test this possibility they added a little chloroform to the sewage; nitrification at once stopped. They then removed the chloroform, and "seeded" with a little fresh sewage; after an interval nitrification began again. This afforded strong evidence that the process was due to living organisms, and in course of time the proof was made more rigid by Winogradsky's isolation of the specific organism.

This research is one of the foundations of modern soil bacteriology, and for this alone Schlœsing would be remembered. But his other work has also played an important part in the development of the subject, and he may justly be regarded as a worthy successor to the great Boussingault, whom he followed at the Conservatoire des Arts et Métiers in 1887. He carried on the high standard set by his predecessor, and leaves a name that will long be held in high honour and esteem.

E. J. RUSSELL.

NOTES.

THE Prime Minister's list of New Year honours, the publication of which has been delayed by circumstances arising out of the armistice, was issued on Monday, and includes the following names of workers in scientific fields:—*Baronet:* Dr. Norman Moore, president of the Royal College of Physicians. *Knights:* Mr. R. T. Blomfield, past president of the Royal Institute of British Architects; Lt.-Col. J. M. Cotterill, C.M.G., consulting and late acting surgeon, Edinburgh Royal Infirmary, and lecturer in clinical surgery, Edinburgh School of Medicine; Prof. Israel Gollancz, secretary of the British Academy since its foundation; Prof. R. A. Gregory, chairman of the Organising Committee, British Scientific Products Exhibition; Mr. H. J. Hall, organiser under the Ministry of Munitions of the section dealing with the production of fertilisers; Dr. Edward Malins; Mr. J. H. Oakley, president of the Surveyors' Institution; Prof. W. Ridgeway, professor of archæology, University of Cambridge; Dr. C. S. Tomes, F.R.S.; and Dr. T. J. Verrall, chairman of the Central Medical War Committee.

THE joint meeting of the Faraday Society and the Röntgen Society, held at the Royal Society on Tuesday for the discussion of "The Examination of Materials by X-rays," afforded remarkable testimony to the wide interest taken in the opportunity which such a meeting provides of bringing together theoretical knowledge and practical experience of a scientific subject. The meeting-room of the Royal Society was crowded, and one twice the size could easily have been filled. The discussion, of which we shall give an account in a later issue, began in the afternoon, and was continued in the evening after adjournment for dinner, to which a large company was invited by the president of the Faraday Society, Sir Robert Hadfield. It was an unusual privilege for the Royal Society to grant the use of its meeting-room for a discussion organised by other societies, but there could not be a more appropriate place for such a meeting, and the society itself might with advantage arrange for similar meetings at which all scientific workers in wide fields are actively interested. The success of the Faraday Society discussions is due chiefly to the rare combination of pure and applied science and unbounded energy manifest in Sir Robert Hadfield, and to the untiring work of the secretary of the society, Mr. F. S. Spiers. It was particularly pleasing to note the number of the younger generation of scientific workers present at the meeting. No more encouraging sign could be

given of the vitality of British science, and we trust that the Faraday Society will be strengthened greatly by increase of membership to continue its valuable work of co-ordinating scientific activities. The address of the society is 82 Victoria Street, Westminster, S.W.1.

UNFAVOURABLE weather has as yet delayed the trans-Atlantic flight, and the aeroplanes, although perfectly ready for the start eastwards, have still to wait for weather conditions which, at all events, will give them some chance of success in their attempt at crossing. There are few days in the course of the year when the whole passage from Newfoundland to Europe is quiet and favourable to the safe passage of aeroplanes. May and June are probably as favourable as any time throughout the year for settled and favourable weather conditions, but this does not mean that such favourable conditions occur in these months every year. At this season there is commonly at times a large amount of easterly wind. On an average there are fewer gales in the North Atlantic, and if storms develop they are of less intensity than at other seasons. In mid-Atlantic fog is most prevalent during the summer season, but an aeroplane would be well above this, although it would prevent passing vessels being seen. In Newfoundland fogs are more prevalent at St. John's than on the north-east coast, the latter part being peculiarly free from fog throughout the year. On our own coasts fogs are most prevalent in the winter. For the last week there can be no doubt about the stormy character of the weather, and the conditions throughout the route have become less favourable than in the preceding week; from this it must not be understood that the conditions have been sufficiently settled for the flight since the aeroplanes have been ready. The heavy snowstorm and gale over England on Sunday last sufficiently illustrate the suddenness of our weather changes. The Air Ministry in its bulletin issued on the evening of April 28 said: "Strong northerly winds, with squalls and much low cloud to the westward of Ireland, continue to render the conditions unsuitable for the flight."

AN excellent summary of the work of our Air Services has been issued as a Parliamentary paper under the title "Synopsis of British Air Effort during the War," and was reprinted in the *Times* of April 24. The enormous growth of the Air Force is illustrated by figures, and an idea of the extent of its activities may be gained from the fact that on the Western front, between July, 1916, and Armistice Day, more than 7000 enemy machines were brought down, nearly 7000 tons of bombs dropped, 10½ million rounds fired at ground targets, and 900,000 flying hours completed. The aid of the man of science has been called for in many ways, apart from the fundamental investigations of aerodynamics and the principles of flight. Examples of this may be found in such important work as the design of oxygen apparatus and electrically heated clothing for use at great altitudes. Photography, again, has played a marvellous part, as may be gathered from the statement that in a single month more than 23,000 negatives were made and 650,000 prints issued. The photographic branch has now 250 officers and 3000 other ranks, and it is estimated that no fewer than five million prints of aerial photographs have been issued by the Air Services in the field. Another great sphere of scientific activity has opened out in connection with the application of wireless telegraphy to aircraft; and this branch of the Service, which was in its infancy in 1914, now possesses 520 officers and 6200 other ranks, numbers which testify to the great progress made. Never before in history has science been so widely and effectively employed as during the recent struggle, and the Air Services alone afford an example which should establish for ever the great value of organised scientific research.

A SNOWSTORM of unusual severity for so late in the season occurred generally over the British Isles on Sunday, April 27, and in the south-east of England the storm was particularly severe. On the morning of Sunday a subsidiary disturbance was developing over the northern portion of the kingdom, and it afterwards moved southwards and eastwards over England, the parent disturbance being centred over Denmark. By the evening the subsidiary had assumed more serious proportions than the primary to the north-eastward, and was now centred over London and the south-east of England. Snow or hail fell in all districts of the United Kingdom. A region of high barometer extended from Iceland to the Azores which caused strong northerly winds in the rear of the disturbance, and gale force was reached in all districts, whilst at Holyhead the wind force attained the velocity of seventy miles per hour during Sunday night. In London snow commenced at about 1 p.m. after somewhat heavy rain, and it thoroughly covered the ground by 3 p.m. The depth of snow by the early morning of April 28 in the north of London was 12 in. to 15 in., and the total precipitation in the twenty-four hours was 1·6 in. at Camden Square and 1·7 in. at Hampstead. The snowfall occasioned much dislocation of the telegraph and telephone services, and the rapid melting of the snow caused floods in many parts. Temperature on April 27 was abnormally low for so late in the season, the thermometer in London during the afternoon standing at about freezing point. Agriculturists and fruit-growers have suffered somewhat badly.

A NEW expedition to the Antarctic is announced to sail in June, 1920. It will be known as the British Imperial Antarctic Expedition, and will be under the leadership of Mr. J. L. Cope, who accompanied the Ross Sea party of the recent Imperial Antarctic Expedition, 1914–17, as surgeon and naturalist. Mr. Cope's plans are ambitious and cover a wide area. Primarily, he aims at ascertaining the position and extent of minerals of economic value in Antarctica, and, by observations on the distribution and migration of whales, to foster the British whaling industry. It is understood that his plans include a base at New Harbour, in Victoria Land, and a wintering party in the middle of the Ross Barrier, mainly with a view to meteorological and magnetical observations. The ship itself, which is to be the *Terra Nova*, a vessel of proved capacity for Antarctic work, will spend the second winter at or around Cape Ann, in Enderby Land. Since that is a part of Antarctica which is practically unknown, a wintering party cannot fail to achieve results of great value. It is proposed to make use of an aeroplane for survey work and facilitating the choice of a route for sledge journeys. It is hoped that by this means Mr. Cope will be able to map the missing coast-line between Enderby Land and Wilkes Land to the east, and between Enderby Land and Coats Land to the west. Later it is proposed to follow the coast of Antarctica from Graham Land to Edward Land. The expedition is expected to last for six years, during which time communication with civilisation will be kept up by wireless telegraphy. While the plans, so far as announced, seem sound and likely to result in valuable discoveries, Mr. Cope might perhaps be well advised to curtail the duration of the expedition by at least two years. In any case, it is practically certain that his ship will require to dock for overhaul and minor repairs after two or three years among the ice.

THE Indian Public Works Department has lost a zealous and capable administrator by the death of Mr. George Thomas Barlow, Chief Engineer and Secretary in the Irrigation Branch of the United Provinces Government. Mr. Barlow's connection with irrigation work in northern India had been long and honourable, dating back in unbroken sequence to the year 1887, when he went out to India after a course of technical training at Coopers Hill, followed by a year of practical engineering work in Scotland. From that time until his death he was continuously engaged on irrigation schemes, at first at various posts on the Ganges, and afterwards, from 1901, in Bundelkund, a trans-Jumna tract of the United Provinces, where he was executive engineer on a considerable number of undertakings for ameliorating drought-stricken areas. Under Mr. Barlow's direction many surveys of different localities were made, numerous reservoirs constructed, and large masonry dams and canals brought into existence. He was promoted Superintending Engineer in 1911, and received the C.I.E. for his services in 1915. The following year he was appointed Secretary to the Government in the Irrigation Branch, and so recently as last October he was placed on deputation with Mr. Meares to undertake a systematic hydro-technical survey of the whole country. He was engaged in these researches up to the time of his death. Mr. Barlow was the author of several text-books dealing with irrigation work.

THE death of Mr. A. McHenry, which occurred somewhat suddenly on April 19, removes one of the oldest and most assiduous workers from the field of Irish geology. For more than forty years Mr. McHenry was on the staff of the Geological Survey, and the first mapping of some of the difficult areas in the north-west of Ireland fell to his share. He was always responsive to new discoveries, and was as enthusiastic in the revision of Silurian rocks by their graptolitic zones as in tracing thrust-planes and possible inversions of succession. His warm-hearted and unselfish character has left an enduring memory from days when controversies were not always conducted with such marked generosity and consideration. The Memoirs of the Geological Survey of Ireland contain ample evidence of his original observations. In addition, Mr. McHenry was the first to point out how the succession of intrusive igneous rocks in the Mourne Mountains corresponds with the volcanic episodes farther north, and he has left behind him unpublished records which may prove to be of considerable service in the elucidation of the problem of the Dingle series.

THE task imposed on industries by the war was the production in quantity of accurately standardised products. To ensure the successful development of peace-time trade, the high standard of accuracy and quality thus set must be maintained, and this is possible only by the institution in each factory of a system of inspection similar to that in operation during the war. Particulars have reached us of a new organisation, called the Technical Inspection Association, which has been formed recently for this purpose. There are doubtless many private firms which desire to set up a system of inspection in order to ensure interchangeability and uniform quality of these products. Such firms will be interested in the new association. The objects of the association are to keep members of the inspection staff of the Ministry of Munitions in close touch with each other, and to develop generally the progress and standardisation of methods of inspection in engineering, chemical, and allied industries with the view of conserving and co-ordinating the experience gained during the war for national use. The work will thus be of considerable scientific interest as well as industrial value. The temporary address of the association is Hotel Metropole, Northumberland Avenue, London, S.W.1.

WE regret to record the death of Mr. Wilfred James Lineham at Brighton on April 22. Mr. Lineham, who was sixty years of age, was well known as a teacher of engineering and as an author of engineering text-books. He was connected with the Goldsmiths' College for thirty years, and was formerly on the staff of the Armstrong College, Newcastle-on-Tyne. He took an active part in the founding of the Association of Teachers in Technical Institutes, and for many years was a member of the engineering faculty of London University. Mr. Lineham was a member of the Institutions of Civil Engineers, Mechanical Engineers, and Electrical Engineers. During the war a great deal of munition work was carried on at the Goldsmiths' College, and there is little doubt that Mr. Lineham's death was accelerated by the heavy work entailed thereby. It is of interest to note that he was an artist, and had exhibited at the Royal Academy. He had many friends, both amongst practical engineers and teachers, and his loss will be deeply regretted.

THE seventy-second annual meeting of the Palæontographical Society was held at the rooms of the Geological Society, Burlington House, on April 25, Dr. Henry Woodward, president, in the chair. The council's report announced the completion of the seventy-first volume of monographs, with instalments of Wealden and Purbeck fishes, Pliocene Mollusca, Cambrian Trilobites, and Palæozoic Asterozoa. Mr. Henry Dewey, Dr. F. L. Kitchin, Mr. W. P. D. Stebbing, and Mr. Henry Woods were elected new members of council. Dr. Henry Woodward, Mr. Robert S. Herries, and Dr. A. Smith Woodward were re-elected president, treasurer, and secretary respectively.

THE death is announced of Dr. Fernand Priem, honorary professor of geology in the Lyceum of Henri IV., and correspondant of the National Museum of Natural History, Paris. Dr. Priem was born on November 10, 1857, at Bergues, near Dunkerque, and studied palæontology under the late Prof. Albert Gaudry. He made many notable contributions to our knowledge of fossil fishes, among which may be specially mentioned his memoir on the fossil fishes of the Paris basin, published separately by the *Annales de Paléontologie* in 1908, and his description of new Cretaceous fishes from Persia included in the report of the Mission de Morgan in the same year

THE annual British Academy lecture on a master mind (Henriette Hertz Trust) will this year have as its subject "Leonardo da Vinci," and be delivered by Mr. C. J. Holmes, director of the National Gallery, in the rooms of the Royal Society on Friday, May 2, at five o'clock, this being the anniversary of the death of Leonardo da Vinci. Sir Frederic Kenyon, president of the British Academy, will be in the chair.

DR. WINIFRED CULLIS and Miss Mona Wilson have accepted membership of the Industrial Fatigue Research Board, recently appointed by the Department of Scientific and Industrial Research and the Medical Research Committee jointly to study questions of industrial fatigue.

SIR HUGH CHARLES CLIFFORD, Governor of the Gold Coast, has been appointed Governor and Commander-in-Chief of the Colony and Protectorate of Nigeria, in succession to Sir Frederick Lugard, who will retire from the Colonial Service in July.

Sir J. G. Frazer contributes to the March issue of *Man* a note by Rai Bahadur K. Ranga Achariyar on the customs of the Todas in connection with the milk of their sacred dairies. In relation to the Hebrew prohibition against seething a kid in its mother's milk, Sir J. G. Frazer has discussed milk taboos in his recent work, "Folk-lore in the Old Testament" (vol. iii., pp. 111 ff.). But all the taboos on the dairy and the milk are meant only for the well-being of the Todas primarily and of the buffaloes secondarily. There is not the slightest trace among them of the belief that the restrictions are in the interests of the buffaloes or for their benefit, or that there is a magical sympathy between the cows and their milk. The parallel between the Toda and Hebrew customs is thus not clearly established, but the facts now fully reported for the first time are of considerable interest.

In *Science* for March 7 and 14, under the title of "The Measurement and Utilisation of Brain-power in the Army," there is a very interesting and valuable synopsis of the work of the American Psychological Section of the Army, which has been under the direction of Major R. M. Yerkes. Within the Army three principal groups of psychologists are recognised: one attached to the office of the Adjutant-General, another to the office of the Surgeon-General, and the third to the division of Military Aeronautics. At first the psychologist was looked upon sceptically, and his *rôle* was supposed to be to assist in the elimination of incompetent neurotics; later, the psychological service was undertaking the assignment of an intelligence rating to every soldier, the selection of men of superior intelligence for special suitable tasks, and the discovery of the intellectually unfit. Very careful tests were chosen, and it became possible ultimately for four psychologists and their attendant clerks to examine one thousand men a day. To supply the necessary *personnel* a school for training in military psychology had to be formed. Although at first even the psychologists were critical about accepting the intelligence rating as a standard of military efficiency, yet as the work progressed it was found that it was the best single factor by which to determine a man's military value. Students of similar intelligence were grouped together for training, thus facilitating the speed and success of the work. It is interesting to note that of all the occupations in the Army the engineering sections contained fewer men of low or mediocre intelligence. It is suggested in the paper that, with suitable modifications, this psychological testing might prove advantageous to problems of civil life.

Sir Edward Sharpey Schafer devoted his presidential address to the Edinburgh University Physiological Society last January to the consideration of "The Position of Physiology in Medicine." He showed that it is "the pivotal subject around which all medical sciences are centred, and furnishes the basis upon which the whole of medicine and surgery is founded." While there can be no doubt that the practice of learning physiology before commencing the study of what is founded upon it is correct, yet it is difficult to convince the student of the importance of what he is taught. He is apt to look upon it merely as an examination subject to be forgotten as soon as the test is passed. For this reason it would seem that there might be some advantage in allowing the student to see something of hospital work at the commencement of his physiological studies. A very short, properly planned, special course would suffice if the interest of the hospital staff could be enlisted. This should be less difficult since the importance of physiology has become so manifest in the war. It is pointed out by Sir Edward Schafer that clinical teaching should be in the hands of those who have a thorough knowledge of physiology, whereas it is comparatively rare to find a medical man who realises how dependent he is on physiological work. It is also strongly insisted upon in this address that practical work is of the greatest importance in the proper understanding of the subject, notwithstanding its cost in apparatus, buildings, and staff. This leads naturally to the emphasising of the vital necessity of generous aid to universities on the part of the State.

Some details of British survey work on the Western front are given by Lt.-Col. H. S. L. Winterbotham in the *Geographical Journal* for April (vol. liii., No. 4). The field survey department grew with the growth of the armies and the new methods of warfare, and managed to meet all the requirements of infantry, artillery, and air force. The existing maps at the beginning of the war were the French 1/80,000, and the plans around fortresses of 1/20,000. In addition, there was a survey on a scale of 1/2500, which was originally made for revenue purposes, and kept in manuscript in the capital of each province: some of these were captured by the Germans early in the war. When trench warfare set in the necessity for a new and accurate large-scale map became apparent. Col. Winterbotham describes some of the difficulties which had to be faced in compiling this map. There was no lack of trigonometrical matter, but it was not easy to reconcile the five systems in existence. The old French triangulation was found to have many defects, not the least being that many of the original fixed points had been destroyed. The Belgian triangulation was perhaps more accurate, but it suffered from the same drawback as regards fixed points. In addition, there were the French Admiralty Survey for the coast, the cross-Channel chain of triangulation made more than fifty years ago, and the new French chain on the Paris meridian and the Amiens parallel. This last survey was connected with the Belgian system with useful results. Difficulty was also experienced in reconciling different data of levels. Col. Winterbotham's paper concludes with some description of how the map was made, and certain other activities of the field survey battalions.

The Decimal Association has issued a reprint of Mr. Harry Allcock's article on "Industrial Reconstruction and the Metric System" which appeared in the *Electrical Review* of January 17. This is a very able exposition of the case for the compulsory adoption of the metric system of weights and measures. The author urges that, in order to prepare public opinion for the new system, the Government should extend the practice adopted in 1913, when the metric carat was prescribed as the standard weight for precious stones, and abolish forthwith all apothecaries' weights in favour of metric weights throughout the trade in fine chemicals and drugs. Many of the multiples of existing British units should, he maintains, be at once discarded, and all quantities be expressed in terms of single units instead of in cwts., qrs., lbs., etc. As regards the argument that until they became expert in the use of the metric system British manufacturers and merchants would be at a disadvantage as compared with similar classes in Germany, Mr. Allcock points out that this temporary handicap must be faced sooner or later, and that it would be peculiarly opportune to face it now, while the sentiment of the world is decidedly anti-German.

A new ferrous alloy with remarkable properties is mentioned in the *Scientific American* for March 1.

The composition appears to be approximately 60 per cent. nickel, 14 per cent. chromium, a little molybdenum, and the remainder iron. It is melted in crucibles and poured into sand moulds. Its tensile strength at air-temperature is 50,000 lb. per sq. in., while at 1800° F. it is still 30,000 lb. It melts at 2800° F., and withstands repeated heatings to 1800° F. and coolings without serious oxidation or diminution of strength. It works well, and can be drawn into wire. It is not acted on by chemicals even when heated, and is already being freely used for the valves and valve-seats of internal-combustion engines and for domestic utensils. The possibility of using the alloy in place of plumbago for crucibles is under investigation, and the results so far obtained are most encouraging. The field of usefulness of an alloy with these properties is obviously extensive, and it is unfortunate that the *Scientific American* gives no hint as to where the material can be obtained.

IN the Proceedings of the Indian Association for the Cultivation of Science (vol. iv., part ii., 1918) Mr. S. Banerji deals with the vibrations of elastic shells partly filled with liquid. The problem here considered is chiefly of acoustical interest in relation to the theory of "musical glasses." This class of instrument consists of a series of thin-walled elastic shells the gravest modes of vibration of which are tuned to form a musical scale by partially filling them with a liquid, and are excited either by striking or by tangential friction on the rims. The principal features of interest requiring elucidation are (*a*) the dependence of the pitch of the vibration upon the quantity of liquid contained in the vessel, and (*b*) the mode of vibration of the liquid itself. These features are discussed in this paper for the three cases in which the elastic shell is respectively (1) a hemispherical one, (2) a cylindrical one with a flat bottom, and (3) a conical cup, these forms approximating more or less closely to those used in practice. The analytical expressions show that the motion of the liquid is very marked near the margin of the vessel, but is almost imperceptible near the centre and at some depth inside the liquid. Numerical results have also been obtained and tabulated, and the graphs plotted, showing the theoretical relations between the quantity of liquid in the vessel and the vibration frequency. The lowering of pitch due to addition of liquid is greatest when the vessel is nearly full.

MESSRS. BERNARD QUARITCH, LTD., 11 Grafton Street, W.1, have just issued a Catalogue (No. 352) of second-hand books and periodicals which they have for disposal. The 1700 odd works listed range over many branches of literature, but the sections relating to natural history and periodicals and transactions of learned societies will appeal more especially to readers of NATURE. In them we notice a set, with supplement, of Gould's "The Birds of Australia," Elwes and Henry's "The Trees of Great Britain and Ireland," Sargent's "The Sylva of North America: A Description of the Trees which Grow Naturally in North America exclusive of Mexico," Butler's "Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum," R. Bowdler Sharpe's "Hand-list of the Genera and Species of Birds," Edwards's "The Botanical Register" (a set), and long runs of the *Berichte* of the Deutsche Chemische Gesellschaft, the *Quarterly Journal of Microscopical Science*, and the Proceedings and Transactions of the Zoological Society of London. The catalogue is published at 1*s*.

THE following books of science and education are announced for early publication:—"Euclid in Greek" (Book i.), Sir T. L. Heath, and "A Short History of Education," Prof. J. W. Adamson (*Cambridge University Press*); "Practical Vaccine Treatment for the General Practitioner," Dr. R. W. Allen (*H. K. Lewis and Co., Ltd.*); "George Westinghouse: His Life and Achievements," F. E. Leupp (*John Murray*); "Scientific Factory Management," Dr. A. D. Denning (*J. Nisbet and Co., Ltd.*); "Gas and Oil Engine Operation," J. O'Kill (*Sir Isaac Pitman and Sons, Ltd.*).

OUR ASTRONOMICAL COLUMN.

THE APRIL METEORS OF 1919.—Observations were obtained at Bristol on the nights of April 18, 20, 21, and 22, but the display was by no means a rich one. The night of chief activity was April 21, when fourteen meteors were recorded between 8h. 40m. and 11h. 35m. G.M.T. Of these, nine were Lyrids and indicated a radiant point at $272°+30°$. Several fine meteors were observed on this night, and particularly at 9.30 and 9.40 G.M.T. The first of these appeared as bright as Sirius, and slowly floated from $236°-1\frac{1}{2}°$ to $246°-2°$ in about 5 secs. This must have been a fine object as seen from the eastern counties of England. The second was one of the true April meteors, with a bright streak, and moved swiftly from $297°+65°$ to $31°+47\frac{1}{2}°$. It was of about the same apparent magnitude as Jupiter.

THE METEORIC SHOWER OF HALLEY'S COMET.—The celebrated comet of Halley has an accompanying meteor system. The shower was discovered in 1870 by Capt. G. L. Tupman, and shown by Prof. A. S. Herschel, a few years later, to exhibit a significant resemblance to the cometary orbit. The meteors are visible in the mornings of the first week in May, and their flights are directed from a point near the equator in R.A. 337° in Aquarius, and close to the stars ζ and η in that constellation. The meteors have not been witnessed in the same splendour and abundance as those of November from Tempel's and Biela's comets, but they are individually very fine objects, traversing long paths extending occasionally over half the visible firmament, and worthy representatives of the notable comet from which they are derived.

The reappearance of this shower is now due, and it is very desirable that a watch for its meteors should be maintained on the next few mornings. We want more data with regard to its duration, whether or not the point of radiation moves eastwards, like that of the Perseids, and what annual differences affect the number of meteors appearing. Double observations of identical objects will be valuable as enabling their heights and velocities to be determined. The materials already acquired affirm that the observed motion is decidedly slower than that implied from theory, and this is probably due to the resistance of the atmosphere. The radiant does not rise until the morning twilight is in evidence, and when a short period only remains available for observation.

Heis, so far back as May 2, 1848, witnessed a rich display of streaking meteors, and this may quite possibly have been an early return of this system.

OCCULTATION OF STARS BY VENUS.—Mr. Arthur Burnet, honorary secretary of the Leeds Astronomical Society, who has achieved success previously in predicting phenomena of this kind, writes to us from France that the stars 79 Leonis, magnitude 5·5, and B.D.+2·2422°, magnitude 8·6, No. 6927 in the d'Abbadia Catalogue (1900), will be occulted by the planet Venus on August 1 next as seen from certain places in the southern hemisphere. Geocentric conjunction of the planet with 79 Leonis will take place on August 1d. 8h. 54m. G.M.T., and the occultation may be seen from South America. Mr. Burnet computes that the duration of the occultation as seen from Rio de Janeiro will be about nine minutes.

Venus will be in geocentric conjunction with the second star on August 1d. 18h. 40m. G.M.T., which is 6h. 10m. in the evening of August 2 by New Zealand standard time, and it is computed by Mr. Burnet that the occultation, which will be of twenty minutes' duration, may be seen from that part of the globe.

CIVILIAN AIR ROUTES.

THE ban on civil aviation is raised from to-day, as announced in the House of Commons on April 14, and the Air Ministry has issued details of some of the aerial routes which will be declared open. The routes are to be regarded as provisional, since experience alone can decide upon the arrangement of aerodromes which is most suitable for carrying out the aerial business of the country. The accompanying map shows the routes and aerodromes which have so far been decided upon.

Air routes and stations. Reproduced from the *Times*.

At the date of the armistice there were 337 aerodromes and landing grounds in the British Isles. About 100 will be required for the Royal Air Force, while 116 have already been relinquished for cultivation and other purposes. This leaves about 120 aerodromes, some with extensive accommodation, which will ultimately be available for civilian purposes. It is considered probable that many of these will eventually be acquired by public bodies and commercial firms, and a list will shortly be issued giving particulars of the aerodromes in question, with the facilities they possess and their distances from important centres, in order to assist intending purchasers.

The main routes at present outlined are summarised below, the London terminus being situated at Hounslow:—(1) London–Scotland; (2) London–Dublin; (3) London–Manchester–Belfast; (4) Continental route *via* Lympne; (5) Dutch route *via* Hadleigh; (6) Scandinavian route *via* New Holland; (7) London–Plymouth; and (8) London–Bristol.

The various aerodromes along these routes are clearly shown on the map, and when any route has been declared open pilots using it will find petrol, accommodation, and, where possible, mechanics to handle their machines at each of these aerodromes. Such pilots must, of course, comply with the regulations as regards licensing and inspection of machines. The Government makes no promise of help to aviators who descend, whether by choice or by force of circumstances, at places other than the official "air stations."

It has been decided to limit the overseas traffic for the present to four "appointed" aerodromes. Three of these will be those named under routes (4), (5), and (6) of the above list, while the fourth will be at Hounslow in order to facilitate direct communication between London and the Continent. These arrangements are, again, only provisional, the problem of the control of overseas traffic being a particularly difficult one, so that it is impossible to fix definitely the Customs stations at the outset.

Rigid supervision with regard to the construction and airworthiness of machines intended for passenger services will be insisted upon, but progress will not be hampered by any inspection of inventions or of purely experimental machines.

It is very encouraging to see the situation so well in hand, and, with the assistance that the Government proposes to give to civil aviators by means of the above scheme, commercial aviation will receive an excellent start in this country. There seems little doubt that full advantage will be taken of the facilities offered, and, in view of the experience gained during the war in the theory and practice of aeronautics, the development of the purely commercial machine should be even more rapid than that of the military aeroplane has been. It is very difficult to attempt a forecast of the future of commercial aviation, but the enterprise invited by the present announcement of the Air Ministry may be expected to provide experience which will very soon give a clear indication as to the possibilities of commercial aircraft.

FORESTRY RESEARCH IN SWEDEN.[1]

THE Swedish Institute of Experimental Forestry, which occupies itself with systematic studies in sylviculture, the botany of trees, forest mensuration, and applied entomology, acquired new buildings near Stockholm in May, 1917, which will add much to its efficiency. The institute continues to publish excellent memoirs on these subjects. The combined volume, Nos. 13 and 14, of 1916–17 contains more than 1300 pages of Swedish text, supplemented by short

[1] Memoirs of the Swedish Institute of Experimental Forestry. Nos. 13–14, pp. 1301+clxxii. (Stockholm, 1916–17.) Price 18 kronor. Also No. 15 pp. 288+xxxii. (1918.) Price 4.50 kronor

abstracts in German, French, or English. These memoirs are profusely illustrated, and replete with statistics, tables, diagrams, and maps.

To the British forester the most interesting of these studies is the monograph on the cultivation of the larch in Sweden by Prof. Gunnar Schotte, which takes up pp. 529–840, followed by twenty-six pages of bibliography, enumerating the books and articles on the larch in various languages. The botanical part is excellent, but the great merit of the work lies in the admirable account of the sylviculture of the three species which are grown in Sweden. Of the European larch forty-two experimental plots have been exhaustively studied, and most of the conclusions arrived at are applicable to British conditions. Prof. Schotte only approves of pure woods of this species on exceptionally good soils. He recommends a mixture of European larch with pine or with beech on moderately good to medium soils, and is convinced that larch should never be planted on poor ground. For the prevention of canker due to Peziza, which is the scourge of this species in Sweden as well as in England, he advocates early, frequent, and heavy thinnings, with the object of removing the feeble and suppressed trees, which are liable to be attacked by the fungus. The Siberian larch, which is comprehensively treated, is successful in Sweden, but quite unsuitable for our climate. Sample plots of Japanese larch in Sweden are still young, but so far this tree is extremely vigorous and immune from disease. Prof. Schotte's article, which is accompanied by an abstract in English, is followed by a report (pp. 841–922) of an elaborate investigation by L. Mattsson on the form of the stem of the larch. The results, which are highly technical, are also given in an English abstract.

A similar investigation (pp. 9–110) by Nils Sylven of the variety of the common pine which is indigenous in northern Sweden is of considerable interest. This tree, distinguished by some botanists as a separate species, *Pinus lapponica*, differs mainly in its more slender pyramidal crown of foliage and in its thinner bark. The plate showing the variations in the form and colour of the seeds and cones of this variety and of the common pine is beautifully drawn. The germination of the seed of the northern pine is dealt with by E. Wibeck in a memoir (pp. 201–34). The insects which attack the cones of the pine and of the spruce as well, and the peculiar fungus, *Melampsora pinitorqua*, are dealt with in separate articles (pp. 1077–1204).

The composition of forest soils and the formation of humus have been investigated by H. Hesselman (pp. 297–528 and 923–1076). Mr. Hesselman distinguishes mild humus usually found in broad-leaved forests, and raw humus characteristic of most coniferous forests. In the latter no nitrification ordinarily takes place, and natural regeneration is rendered difficult by the feeble growth of the seedlings in the absence of nitrates. He also points out the measures which can be adopted to transform the raw humus, such as partial felling, which admits light on the ground and brings about a radical alteration in the bacterial flora. The change undergone by the humus is accompanied by an alteration in the ground vegetation. When the nitrogen is transformed into nitrate, plants like raspberry, *Epilobium angustifolium*, *Senecio sylvaticus*, etc., appear. In the absence of this transformation, *Aira flexuosa* is the predominant plant in the clearings of the forest. Hesselman's investigations are of considerable interest to ecologists.

The fifteenth volume of the memoirs, just received, contains a number of miscellaneous articles: on a new plough designed by Mr. Widen; on the seed crop of the principal trees of Sweden during 1917; on the attacks of the more important insects and of the fungus *Melampsora pinitorqua* during the same year; and on a new method of ascertaining the form and volume of single stems of spruce. The programme of the investigations to be carried out by the institute during the triennial period, 1918–20, is also given.

PLANTATION RUBBER RESEARCH.

MESSRS. EATON, GRANTHAM, AND DAY have published (Department of Agriculture, Federated Malay States: Kuala Lumpur) an account of important researches carried out in Kuala Lumpur, Malaya, during the last three and a half years in connection with the preparation and vulcanisation of plantation rubber. The Bulletin runs into 398 pages, and gives one of the most detailed accounts of rubber research in Malaya yet published. The authors point out that they, as Government officials, are working under difficulties in so far that, whereas they give full publicity to their methods and results, they are precluded from gaining knowledge of the methods adopted or apparatus used by other technologists in Malaya and London who are carrying on similar experimental work with rubber. It is clear that the policy of secrecy adopted by companies and associations which privately employ chemists and mycologists in the East is open to very grave objection. The policy of secrecy is not only against the true scientific spirit, but must also, in the long run, seriously reduce the value of research even to those who privately employ their own technologists. All scientific work should be open to criticism based upon knowledge of the method and apparatus employed. The present unsatisfactory arrangement may work well enough for privately employed technologists who have the advantage of studying detailed accounts of methods employed by Government officials; the reverse, however, is obviously not the case.

Considerable energy appears to have been thrown into the researches on variability of plantation rubber, a subject which raises hostility among owners of plantations who consider that their finished product cannot be improved upon. We have never agreed with those plantation producers who refuse to believe in the variability of plantation rubber, and the fact that they have introduced the word "uniformity" in a comparative sense does not blind us to the real position.

The authors, as a result of their work, believe that the ordinary forms of smoked sheet and crêpe, now so common in the markets of the world, will be superseded by a new type of rubber turned out in "slabs." If it is true that the rubber prepared in slabs is superior to the common forms now produced, a great advance will have been made.

The problem of vulcanisation has been investigated in an unusual direction. It is claimed that in connection with organic vulcanisation accelerators a discovery has been made which ranks only second with the original discovery of vulcanisation by Goodyear and Hancock. The authors have demonstrated that valuable vulcanisation accelerators are present in Hevea latex, and can be formed by special treatment of the coagulum. A number of vulcanisation accelerators were sent by the present writer to these investigators in 1915; they appear to have led to an interesting line of research which should have far-reaching results. The discovery of the vulcanisation accelerators in Para rubber was made prior to the authors' knowledge of the discovery and use of patent organic accelerating agents. The accelerator found in rubber is said to be produced by the decomposition of the proteins, and to consist probably of an amino-acid or amine. The substances found in plantation rubber are responsible

for variability in rate of vulcanisation. In addition, the authors point out that this variability in respect to rate of cure exists in technical mixings with which manufacturers load the rubber. These mixings are largely mineral constitutents in addition to sulphur. It is further contended that the use of strong accelerating agents, such as oxide of lead, tend to obscure the differences produced in raw rubber by the presence of a natural accelerator.

Recommendations are made to planters which, if adopted, should considerably reduce variability. They are:—

(1) Dilution of latex to a constant rubber content.

(2) The use of acetic acid or other weak organic acid (such as formic acid) as a coagulant.

(3) All coagulating-tanks should be standardised so that the final rubber sheets or crêpe are of the same thickness after rolling.

(4) Conditions of drying and smoking, especially during the early stages, should be kept as uniform as possible.

It is pointed out that if sheets of rubber are of varying thicknesses the rates of drying will be different, and, consequently, there will be more variation in the biological changes which take place during the early stages of drying rubber. H. W.

THE SENSITIVENESS OF PHOTOGRAPHIC PLATES TO X-RAYS.[1]

ALTHOUGH observations have been published on the effect of X-rays on photographic plates, the constants of various plates in use do not appear to have been determined. These experiments follow the standard methods of sensitometry of photographic plates to light in respect of exposure of the plate in strips, of development at a standard temperature and for a constant period (namely, hydroquinone at 20° C. for four minutes), and of the subtraction of the density of a fog strip. The density, *i.e.* the logarithm to the base *e* of the ratio of the intensity of the incident to that of the transmitted light, was determined by a polarisation photometer.

The "exposure" E is defined by the relation $E=V^2it/d^2$, where V, volts, is the pressure applied to the Coolidge tube; *it*, coulombs, the quantity of electricity passing through the tube during the exposure of *t* seconds; and *d*, cms., the distance of the focal spot from the photographic plate. This expression gives the energy of the incident rays. Three values for V were used—31,500, 73,000, and 83,000. The current varied between 0·03 and 0·06 milliampere, which is lower than the currents ordinarily used in radiography. Experiments are in progress using higher intensities of radiation.

When the density, D, for a given plate is plotted against the logarithm of the exposure as above defined, a curve similar to those of Hurter and Driffield is obtained. For densities from 0 to about 1 the curve is convex to the log E axis; above that it is straight to densities of 4, the maximum measured. The intercept on the log E axis of the straight line produced backwards is the logarithm of the inertia of the plate, which was found to be independent of the development. This result is the same as for exposure to the visible light. The slope of the straight portion of the curve gives the contrast. A high value for the contrast is one of the desirable properties of an X-ray plate. The "speed" of a plate may be tentatively defined as the reciprocal of the exposure required to produce a density of 5.

[1] Abstract of a paper by Miss N. C. B. Allen and Prof. T. H. Laby read before the Royal Society of Victoria on August 8, 1918.

The density produced in a given plate was found to be constant for a constant value of the exposure V^2it/d^2 over the range V 31,500 to 83,000, and for a limited variation of *i* and *t*, but not for a large variation of *i* and *t*. This means that, for the wavelengths used, the density of a plate depends, not on the wave-length, but only on the energy of the X-rays.

Plate	Inertia	Contrast	Speed
Paragon ...	$0·74\times10^3$	2·4	0·00017
,, ...	1·18	2·3	0·000096
Diagnostic ...	0·71	2·2	0·00015
Sunic	1·00	2·35	0·00012
Seed	1·12	1·9	0·000066
Wratten	1·95	2·2	0·000052
Wellington ...	1·70	2·0	0·000050
Imp. X-ray ...	1·26	1·6	0·000036
Cramer	2·14	1·9	0·000035
Ilford	2·19	1·9	0·000033
Imp. S.R. ..	1·45	1·55	0·000028

RAINFALL VARIATIONS.

AT the meeting of the Royal Meteorological Society held on April 16, two papers on variations of rainfall were read. The papers are summarised below.

Mr. A. A. Barnes, in his paper on rainfall in England, the true long-average as deduced from symmetry, stated that it has been usual to assume that the average annual rainfall during any period of thirty-five years can be adopted for obtaining the "long-average" at any rain-gauge, but he considers that the fluctuations which occur between such averages for various thirty-five-year periods tend to show that the basis is somewhat uncertain. By an exhaustive analysis of the annual readings at thirty-eight rain-gauges in England during the sixty-two years 1856–1917, he shows that variations of as much as 5 per cent. on each side of the mean are quite possible when dealing with successive thirty-five-year periods. From these same records it is then shown that far greater consistency in the value of the average can be obtained by taking periods symmetrical about the end of the year 1886. Both by means of tables and diagrams Mr. Barnes shows that that date is a very critical one in regard to rainfall in England, and that, as a rule, the years before that date were relatively far wetter than years subsequent to it. Hence the balancing of the earlier wet years by the later dry years establishes the principle of symmetry about that date, and it is shown that by this method the maximum departure from normal which results from taking each of the fifteen long periods symmetrical to the end of the year 1886 does not exceed 1 per cent. in the case of any of the thirty-eight gauges which were examined.

Mr. C. E. P. Brooks's paper was on the secular variation of rainfall. In order to obtain a measure of the secular variation of rainfall during the past thirty to fifty years, correlation coefficients were worked out between the annual rainfall at each station and "time," the measure of the latter being the number of years before or after the middle year of the series. This was done for 162 stations distributed over the globe, and the results were charted on a map. This map shows that the greater part of the world is divided among a few definite regions of wide extent, in each of which the rainfall has been either increasing or decreasing. The most important area of increasing rainfall is temperate Eurasia (except the western sea-board); other areas are south-east South America and the south of Australia. Areas of decrease are the tropical regions as a whole, South Africa, and the west coast of Europe. It is noted that the number

of sun-spots, and also that of solar prominences, during the period in question have been decreasing. For a few stations records of longer period are dealt with, giving indications that the results obtained are due to a periodicity of upwards of fifty years.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Prof. F. Soddy, F.R.S., professor of chemistry in the University of Aberdeen, has been elected to the second chair of chemistry recently established in the University.

Dr. F. A. Lindemann has been appointed to succeed Prof. Clifton in the chair of experimental philosophy. Dr. Lindemann graduated Ph.D. in the University of Berlin in 1911 by a thesis on specific heats at very low temperatures, such as become possible by the use of liquid air, and much of his early work was connected with that subject. Afterwards in Paris he collaborated with the Duc de Broglie and other French physicists, especially on the subject of radio-activity. During the war he was attached to the scientific side of the Air Service, and was in charge of the laboratory of experimental physics at Farnborough.

The late Dr. Henry Wilde, whose death occurred recently at the age of eighty-five, was a notable benefactor of the University. He was the founder of the Wilde readership in mental philosophy, of the Wilde lectureship in natural and comparative religion, and of the John Locke scholarship in mental philosophy.

Among the lectures announced in connection with the school of geography are courses on physical geography in its relation to the life of man (Mr. Beckit), extra-tropical Africa (Miss MacMunn), geographical factors in the economic development of British North America (Mr. Cossar), and the geography and ethnology of the eastern Mediterranean (Prof. J. L. Myres).

The committee for anthropology announces courses on ethnology (Miss Czaplicka), comparative technology (Mr. H. Balfour), and informal instruction on the Bronze and Early Iron ages (Mr. Leeds), questions relating to ancient Egypt and Babylon (Mr. Griffith and Mr. Langdon), Indian archæology (Prof. Macdonell and Mr. Vincent Smith), and primitive language in its relation to thought (Prof. J. A. Smith).

Dr. Marett will lecture on primitive law, and hold classes on primitive religion in relation to morals and on ethnological questions.

MR. W. M. JONES has been appointed lecturer in physics at the University College of North Wales, Bangor.

CAPT. W. A. ANDREWS has been appointed lecturer in wireless telegraphy at the Cardiff Marine Technical School. He has hitherto been an inspector of wireless operators in connection with the R.A.F.

THE following special lectures have been arranged for delivery in the Metallurgical Lecture Theatre of the Royal School of Mines, South Kensington, at 4 o'clock each day:—"The Smelting of Zinc Ores," J. C. Moulden (May 1); "Sulphuric Acid Manufacture," R. Curtis (May 6); "Factors in Mineral Flotation," H. L. Sulman (May 13 and 15); and "The François Cementation Process," H. F. Marriott (May 20). Admission to the lectures is free to all.

MR. LAWRENCE PHILIPPS has offered University College, Aberystwyth, the sum of 10,000*l*. to found a plant-breeding institute for Wales in connection with the agricultural department of the college. He has guaranteed a further sum of 1000*l*. per annum for ten years towards the maintenance of the institution. The governors of the college have appointed Mr. R. G. Stapleton, who was for some years connected with the college as advisory botanist, to a chair of agricultural botany and to the directorship of the new institution.

DR. J. E. M. FINCH, who died on February 5, bequeathed 5000*l*. to "the Mayor, Aldermen, and Burgesses of Leicester for the endowment of a university for Leicester in remembrance of his long services as medical superintendent of the Borough Asylum." It is understood that the bequest is for the East Midland University, with which Leicester is to be associated, and the seat of which will be University College, Nottingham, as described in an article in NATURE of February 13.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, April 9.—Mr. G. W. Lamplugh, president, in the chair.—W. **Whitaker**: The section at Worms Heath (Surrey), with remarks on Tertiary pebble-beds and on clay-with-flints. (With petrological notes on the beds at Worms Heath by G. MacDonald **Davies**.) The chief pit now shows a fine set of more or less vertical pipes in the chalk, filled with pebbles and sand of the Blackheath beds, separated from the chalk by clay-with-flints. The pebble-beds here, like those elsewhere, consist of well-rolled black flint-pebbles, amongst which pebbles of a brownish quartzite are occasionally found. It is concluded that the water in which these flint-pebbles were formed touched no other firm rock than chalk; but, as there are no sub-angular flints, the deposition of the beds cannot have taken place close along a chalk coast. From a consideration of older Tertiary pebble-beds it seems that these are not big enough to have afforded the material for the Blackheath beds. On the other hand, the Blackheath beds may have yielded the pebbles of the Bagshot series in Essex, though not in Hampshire. As to the clay-with-flints, it is inferred that it is not a deposit of definite age, but a residual product, representing a condition of things that may have held through long geologic ages, from the start of the Blackheath beds to the present time. Mr. G. M. Davies gives a petrological description of the chalk, of the clay-with-flints (both grey and red), of the Eocene sands, sandstones, and pebble-beds.

Mathematical Society, April 24.—Mr. J. E. Campbell, president, in the chair.—K. **Ananda Rau**: (1) Lambert's series. (2) The relations between the convergence of a series and its summability by Cesàro means.—G. H. **Hardy** and J. E. **Littlewood**: A Tauberian theorem for Lambert's series.—Prof. W. H. **Young**: A formula for an area.

MANCHESTER.

Literary and Philosophical Society, April 1.—Mr. W. Thomson, president, in the chair.—S. **Lees**: The superposing of two cross-line screens at small angles, and the patterns obtained thereby. The author discusses in this paper the general characteristics of the patterns obtained on superposing two half-tone plates of like type at small angles θ. More particularly the cases of (i) intaglio, (ii) ordinary half-tone, (iii) "chess-board" screens are discussed. In each of these cases it is shown that the coarse square framework which arises is similar in type to that of each of the constituent screens.—Lieut. W. A. **Macfadyen**: Electrolytic iron deposition. The work described was undertaken with the view of obtaining data on which an industrial process could be built up for the purpose of salving worn steel parts by electro-plating

them with iron. An aqueous solution of ferrous ammonium sulphate was the electrolyte used, and it was found that, whilst excellent results could be obtained from dilute solutions at the normal room temperature, deposition could be carried out only very slowly; with a concentrated solution, however, equally good results were obtained at about seven times the rate usable in the former case. Varying acidity of the solution proved to have a great effect on the deposits, and the best results were given by an electrolyte made about 0·005 normal with respect to sulphuric acid. By heating the bath to a temperature of 60° C., deposition from a concentrated solution could be carried out satisfactorily at a rate of up to fifty times that which was possible in the case of the dilute cold solution. Iron can be deposited direct on to steel, and subsequent heat-treatment produces an adhesion of the deposit to the basis metal very much better than the best attainable by simple plating, and the deposited iron is much tougher than before treating although it is considerably softer. Such deposits can also be case-hardened with good effect.

DUBLIN.

Royal Dublin Society, April 15.—Prof. H. J. Seymour in the chair.—Dr. Joseph **Reilly** and E. **Ralph**: The system *n*-butyl alcohol-acetone-water. The production of a mixture of *n*-butyl alcohol and acetone on an industrial scale by a fermentation process has rendered desirable a knowledge of this system. Methods of obtaining the composition of mixtures by a determination of acetone by a modification of Messenger's method, and *n*-butyl alcohol by an adaptation of the method of Verley and Bolsing for hydroxyl estimation, are indicated. It was shown that the percentage composition of mixtures is more readily found by determination of a physical constant, such as specific gravity, together with one chemical estimation. Tables and curves drawn with both rectangular and triangular co-ordinates, giving densities over a wide range of mixtures are recorded. The limits of miscibility of *n*-butyl alcohol and water were experimentally found.

PARIS.

Academy of Sciences, April 7.—M. Léon Guignard in the chair.—G. **Bigourdan**: The large instruments and the work of Le Monnier at the observatory of the rue Saint-Honoré.—E. **Ariès**: Formula giving the density of a fluid in the state of saturation.—G. **Julia**: Some properties of general meromorphic functions.—N. **Kryloff**: Some approximation formulæ based on the generalisation of quadratures.—G. **Guillaumin**: Ram-strokes in mains of variable diameter and formed of conical parts.—L. **Dunoyer**: A route-indicator for aerial navigation by dead reckoning.—E. **Alilaire**: The spontaneous inflammation of mixtures of air and ether vapour. After testing mixtures of air and ether vapour at varying temperatures in presence of a number of catalysts, oxides of iron, copper, nickel, etc., the latter being apparently without influence on the phenomenon, it was found that spontaneous inflammation of a mixture of air and ether commenced at about 190° C. By working in tubes of larger diameter it is probable that this inflammation would take place at a lower temperature. The possibility of accidents in factories where large quantities of ether are used, by contact with pipes containing superheated steam, is pointed out.—MM. **Portevin** and **Garvin**: The formation of troostite at low temperatures in carbon steels and the influence of the temperature of immersion in interrupted tempering. If the tempering of the steel is interrupted by suddenly withdrawing the mass from the cooling-water, the temperature of the steel is called the temperature of immersion. When the tempering velocities are well above the critical velocities, interruption of the tempering causes marked recalescence (80° C.) at temperatures down to 450° C., and troostite is obtained after cooling.—Ph. **Glangeaud**: The volcanic group of the Aiguiller, Monts Dore: its secondary and peripheral volcanoes.—Ch. J. **Gravier**: Pedogenesis and viviparity in the Actinia.—E. **Gravier**: Remarks on the preceding paper.—H. V. **Vallois**: Some characters of the femur of Pithecanthropus.—G. **Bertrand**: The high toxic power of chloropicrin towards certain of the lower animals, and the possibility of employing this substance as a parasiticide. Chloropicrin is readily made on the large scale, is easily stored, and in concentrations of 0·01 to 0·12 gram per litre of air kills the larvæ of various noxious Lepidoptera and Hymenoptera. In solution in water chloropicrin is equally very toxic for infusoria, and will probably be of service for the partial sterilisation of soils.

April 14.—M. Léon Guignard in the chair.—G. **Bigourdan**: The works of Le Monnier on the stars and physics of the globe.—A. **Laveran**: The artificial acentrosomic varieties of Trypanosomes. In 1911 an acentrosomic variety of *Trypanosoma evansi* was obtained by the action of oxazine. This variety has been cultivated through mice since 1911, and in April, 1917, after the 450th passage, these organisms were still acentrosomic, and there seemed good ground for assuming that the disappearance of the centrosome was definite and permanent. In April, 1918 (870 passages through mice), the Trypanosomes still remained acentrosomic, but an examination of the blood of the mice in October, 1918 (the 945th passage), showed a large number of Trypanosomes with well-defined centrosomes. Finally, in January, 1919, after 978 passages, all the centrosomes showed normal dimensions. The result of this long experiment shows the necessity for caution in dealing with a supposed definite new variety produced in a living organism.—M. Bigot was elected a correspondant for the section of mineralogy in succession to W. Kilian, elected non-resident member.—P. **Lévy**: The generalisation of the Laplace equation in the functional domain.—E. **Bompiani**: Quasi-asymptotic curves of surfaces in any space.—S. **Lefschetz**: Abelian varieties.—G. L. **le Cocq**: A very general property of cables used for aerial transport.—P. **Janet**: An electro-technical analogy of sustained oscillations.—C. **Chéneveau** and R. **Audubert**: Absorption by turbid media. Application to the estimation of suspensions.—P. **Vaillant**: Polarisation with alternating current.—F. **Michaud**: The mechanical and osmotic action of radiant energy on the media which it traverses.—A. **Kling** and R. **Schmutz**: The characterisation and estimation of carbon oxychloride. A saturated aqueous solution of aniline proved to be the best reagent for phosgene. Diphenylurea is quantitatively produced; this is insoluble in water, and is readily characterised by its crystalline form and melting point. The method may be applied either to the estimation of carbon oxychloride highly diluted with air or in liquid commercial phosgene.—A. **Brives**: The Suessonian in Central Morocco.—P. **Bertrand**: The plant zones of the Coal Measures of the North of France.—P. **Pruvost**: Comparison between the Coal Measures of the North of France and those of Great Britain, according to the succession of fauna.—L. **Dunoyer** and G. **Reboul**: The utilisation of measurements of the velocity of wind at different altitudes for the prediction of barometric variations. When the wind velocity is found to increase with the altitude, a fall of the barometer is to be expected; conversely, if the velocities decrease with the height, the barometer will rise.

—F. **Morvillez**: The leaf-conducting apparatus of the Leguminosæ.—R. **Souèges**: The embryogeny of the Polygonaceæ. The development of the embryo in *Polygonum persicaria*.—F. **Vlès**: The transmission of light through emulsions of bacteria and blood corpuscles.—MM. **Lambert**, **Vlès**, and **de Watteville**: An opacimeter for use in bacterial estimations. This consists of a photometer of two circuits starting from the same source of light, one traversing the emulsion, the other submitted to a system permitting a variation of the intensity according to a known law. A diagram of the apparatus is given, together with a detailed account of the mode of standardising.—C. **Nicolle** and C. **Lebailly**: Hidden experimental infections. Examples drawn from the study of exanthematic typhus. Examples are given of the inoculation of rats and guinea-pigs with typhus in which there was no sign of the reality of the infection except the transmission of the disease by the blood to another animal. This is a different type from latent infection, as here the disease evolves in the experimental animal with its periods of incubation, infectious state (septicæmia and virulence), and cure, with no sign that can be noted by the observer. The name *infections inapparentes* is proposed for this class. There seems no reason to suppose that such facts are applicable to typhus only.—E. P. **Césari**: The maturation of the sausage. The ripening and flavour of sausages are due to the action of yeasts, three new species of which have been isolated.

BOOKS RECEIVED.

From Nebula to Nebula; or, The Dynamics of the Heavens. By G. H. Lepper. Fourth edition. Pp. 401. (Pittsburgh, Pa.: G. H. Lepper.)

Lowson's Text-book of Botany (Indian Edition). Revised and Adapted by Bubal Sahni and M. Willis. New and revised edition. Pp. xii+610. (London: W. B. Clive.) 8*s*. 6*d*.

A Contribution to the Physiology of the Fresh-water Sponges (Spongillidæ). By H. van Trigt. Pp. vi+220+vi plates. (Leiden: E. J. Brill.)

The Fundamental Equations of Dynamics and its Main Co-ordinate Systems Vectorially Treated and Illustrated from Rigid Dynamics. By F. Slate. Pp. ix+233. (Berkeley: University of California Press.)

Worlds not Realised. By W. J. Jupp. Pp. 94. (London: Headley Bros. Publishers, Ltd.) 2*s*. 6*d*. net.

Beverages and their Adulteration, Origin, Composition, Manufacture, Natural, Artificial, Fermented, Distilled, Alkaloidal, and Fruit Juices. By Dr. H. W. Wiley. Pp. xv+421+11 plates. (London: J. and A. Churchill.) 21*s*. net.

DIARY OF SOCIETIES.

THURSDAY, May 1.

Royal Institution, at 3.—Dr. H. S. Hele Shaw: Clutches.

Linnean Society, at 5.—J. Small: The Pappus in the Compositæ.—Montagu Drummond: Notes on the Botany of the Palestine Campaign: I. The Flora of a Small Area in Palestine.—H. N. Dixon: Mosses from Deception Island.

Institution of Electrical Engineers, at 6.—Dr. C. Chree: Magnetic Storms.

Chemical Society, at 8.—Prof. J. H. Jeans: The Quantum Theory and New Theories of Atomic Structure.

FRIDAY, May 2.

Royal Institution, at 5.30.—Prof. J. W. Nicholson: Energy Distribution in Spectra.

Institution of Mechanical Engineers, at 6.—Dr. W. H. Hatfield: The Mechanical Properties of Steel, with Some Consideration of the Question of Brittleness.

SATURDAY, May 3.

Royal Institution, at 3.—Prof. H. S. Foxwell: Chapters in the Psychology of Industry.

MONDAY, May 5.

Society of Engineers, at 5.—C. O. Bannister: Heat Treatment of Steel.

Aristotelian Society, at 8.—Prof. J. B. Baillie: The Stereoscopic Character of Knowledge.

TUESDAY, May 6.

Royal Institution, at 3.—Prof. A. Keith: British Ethnology—The People of Wales and Ireland.

Institution of Civil Engineers, at 5.30.—*Further Discussions*: G. Hughes: The Electrical and Mechanical Equipment of the All-Metal Cars of the Manchester-Bury Section, Lancashire and Yorkshire Railway.—F. E. Gobey: All-Metal Passenger Cars for British Railways.

Röntgen Society, at 8 (at Royal Society of Medicine, 1 Wimpole Street, W.1).—Prof. W. M. Bayliss: Silvanus Thompson Memorial Lecture—The Electrical Changes in Active Tissues.

WEDNESDAY, May 7.

Royal Society of Arts, at 4.30.—J. S. Highfield: The Supply of Electricity.

Geological Society, at 5.30.—Major Reginald W. Brock: Observations on the Geology of Palestine.

British Psychological Society (Educational Section), at 6.—Prof. C. Spearman: Mental Tests for Vocational Guidance.

THURSDAY, May 8.

Institution of Electrical Engineers (Joint Meeting with the Iron and Steel Institute), at 2.30.—J. Bibby: Developments in Iron and Steel Electric Furnaces.—W. H. Booth: The Booth-Hall Electric Furnace.—H. A. Greaves: Application of Electrical Energy to the Melting of Metals.—R. G. Mercer: Electric Furnaces in the United Kingdom, 1918.—Axel Sahlin: A New Type of Electric Furnace.—Victor Stobie: Large Electric Steel Melting Furnaces.

Royal Institution, at 3.—Dr. H. S. Hele-Shaw: Clutches.

Institution of Mining and Metallurgy, at 5.30.—Annual General Meeting.—Hugh K. Picard: Presidential Address.—H. Standish Ball: The Work of the Miner on the Western Front, 1915–18.

Optical Society, at 7.30.—Prof. F. J. Cheshire: Presidential Address—Polarised Light.—J. Rheinberg: Graticules.

FRIDAY, May 9.

Royal Astronomical Society, at 5

Royal Institution, at 5.30.—Sir George Macartney: Chinese Turkistan—Past and Present.

Malacological Society, at 6.—G. B. Sowerby: A New Species of Ampullaria in the Geneva Museum.—Dr. A. E. Boycott: Parthenogenesis in *Paludestrina jenkinsi*.—Tom Iredale: Notes on the Mollusca of Lord Howe Island.

SATURDAY, May 10.

Royal Institution, at 3.—Prof. H. S. Foxwell: Chapters in the Psychology of Industry.

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THURSDAY, MAY 8, 1919.

JOSEPH BLACK.

The Life and Letters of Joseph Black, M.D. By Sir William Ramsay. With an Introduction dealing with the Life and Work of Sir William Ramsay, by F. G. Donnan. Pp. xix+148. (London: Constable and Co., Ltd., 1918.) Price 6*s.* 6*d.* net.

THIS little book has a special interest in being the last published work of the late Sir William Ramsay. As Prof. Donnan states in his graceful appreciation of the author's life and work, Ramsay possessed an intimate knowledge and true perception of Black's position in the history of science, and as they were both *alumni* of the same *alma mater* (the University of Glasgow) it was exceedingly appropriate and a charming act of piety that he should have paid such a tribute to the memory of one with whose name and fame that university is so closely identified.

At the same time it cannot, in strict truth, be said that we have thereby gained any fresh light on Black's life and character, or on the nature and influence of his work. Nor was this to be expected. Practically all that can be said concerning his personal history, his habits, his occupations, his intellectual powers, his social gifts, and his influence as a teacher was said long ago by his successor and biographer, Robison, and his contemporaries, Playfair and Brougham, and it has been summarised in Thomson's well-known account. Indeed, says Ramsay with that quaint turn of humour and gentle irony so characteristic of him, "Dr. Thomas Thomson found Dr. Robison's estimate of Black's character so just that he appropriated it almost verbatim in his 'History of Chemistry' without the formality of quotation marks."

As regards, too, the influence of Black's work and teaching, there is nothing fresh to be learned. History has set its seal upon them, and posterity will accept the verdict. There will be no appeal. Epoch-making as Black's services to science were, few men of such eminence ever furnished so little material to the historian. His great achievements were made at the very outset of his career. He became famous almost at a bound, and for upwards of forty years he lived upon his reputation, augmenting it, indeed, by the wise and philosophic insight, the depth and range of his knowledge, liberality of thought, and sound judgment with which he impressed his colleagues and contemporaries, and influenced and stimulated his students. To all this Sir William Ramsay bears admirable testimony. The subject was evidently congenial to him, and the story as told by him was well worth the telling. For Robison's biography is practically forgotten except by bibliophiles, and Thomson's "History," a compilation of no great merit, and mainly of value for its record of events within the author's personal experience, is probably never looked into by the modern student. What is worth preserving in it, from the point of view of history, has long since been incorporated into later and more important works.

A physician with a very limited practice, whose energies, such as they were, were almost wholly engrossed in the work of preparation for his lectures on chemistry, mainly to medical students, of feeble health and little physical vigour, Black lived a singularly tranquil and uneventful life. His constitutional weakness predisposed him to indolence, and he was incapable of any sustained mental exertion. Literary composition was evidently irksome to him. His correspondence might have been as world-wide as his fame had he cared, or been able, to maintain it. But a valetudinarian before he had reached middle life, he attained the allotted span only by the strictest regimen and by a routine almost monotonous in its regularity.

Moreover, the conditions both at Glasgow and at Edinburgh offered little inducement to experimental inquiry; in those days there was nothing in the nature of laboratory instruction to students, nor had Black facilities for working by means of assistants. Still, had he possessed something of the zeal and enthusiasm of a Scheele or a Priestley, he would have triumphed over these obstacles, for Black was not a poor man, and was well able to afford the expense of tilling the field of inquiry, especially in the domain of heat, which he had opened out for himself. As it was he left it to others to garner the rich harvest which lay ready to his hand had he only had the will and the vigour to gather it. Not that Black was careless of, or indifferent to, his reputation. He complained, and with good cause, of the manner in which his pioneering work was ignored by his French contemporaries, and he was consequently annoyed by the fulsome flattery addressed to him by Lavoisier when it became known that he was not indisposed to accept the doctrine of the anti-phlogistians. But he never sought for honours and distinctions or marks of recognition by foreign academies, and was genuinely surprised, and with an almost childlike gratification, when he received them.

Sir William Ramsay's pen-portrait conveys a vivid and lifelike presentment of a guileless, unaffected character, a man of strict integrity, perfectly transparent, firm and constant in his friendships, of a cheerful, lovable disposition, easy of approach, affable and courteous in bearing, and honourable in all transactions and social obligations. He lived a serene and unembittered existence, wholly unmoved by faction and undisturbed by polemical strife. He died as he had lived, and his gentle spirit left him when seated in his chair, without the slightest sign of even momentary pain.

The student of chemistry who is at all interested in the personal history of the science will read this book with pleasure and profit, for no better instance of the happiness and contentment that attend a life free from worldly troubles, and devoted to the unselfish pursuit of science and to the contemplation of its truths, can be found than in that of Joseph Black, who is to us, as he was to his contemporaries, one of the greatest ornaments of his age.

THE FUNCTIONS OF THE INTERNAL EAR.

Equilibrium and Vertigo. By Dr. Isaac H. Jones. With an analysis of pathologic cases by Dr. Lewis Fisher. Pp. xv+444. (Philadelphia and London: J. B. Lippincott Co., 1918.) Price 21*s*. net.

ALTHOUGH the internal ear or labyrinth of man's body is so small that it may be placed within a hazel-nut of moderate size, it contains two organs of the first importance—one for the recognition of sound, the other for the recognition of movement. A hundred years ago anatomists and physiologists had no suspicion that the internal ear was a double organ. When John Hunter discovered that fishes had an elaborate internal ear or labyrinth, with three well-developed semicircular canals, he believed he had established as a fact that fishes are furnished with the power of hearing. The discovery made by Flourens in 1825 that a partial or total destruction of the semicircular canals of a pigeon deprived the bird of all power of controlling its movements was altogether unexpected and puzzling. No one had suspected that the vertebrate animal was furnished with an organ which silently answered the purposes of a mariner's compass, nor could it have been anticipated that such an instrument should form part of the apparatus known as the internal ear or labyrinth.

After the initial discovery by Flourens our knowledge of the equilibrating function of the labyrinth developed slowly and intermittently, being regarded as a matter of mere academical interest until 1905. In that year Robert Bárány, lecturer on aural surgery in the University of Vienna, made a chance observation which led to a knowledge of this obscure and silent function of the ear becoming a matter of immediate practical importance to every medical man. Bárány noted that when he douched the ear-passage of a patient with cold water, the eyes immediately swung in one direction; when he employed hot water in place of cold, the eyes moved in a reverse direction. He immediately suspected, and proceeded to prove, that the douches set up convection currents of opposite directions in the adjoining semicircular canals, the cold douche giving a downward flow, the hot one in a reverse direction. If there was a diseased or disordered condition of the canals, then no response was given by the eyes, because the automatic mechanism which fixes the gaze on an object when one's head is turned no longer acts.

In 1909 Bárány made the further and even more important observation that the action of every muscle of the body was influenced by messages or stimuli which arise in the semicircular canals and adjoining parts. When he set up currents within the canals either by douching or by seating the patient on a rotating chair, he found that the power of carrying out precise movements was lost in every part of the body. Thus the canalicular mechanism of the ear establishes a connection with every part of the executive elements of the central nervous system. By testing the reactions yielded by the semicircular canals, the physician can explore the central nervous system and ascertain whether or not a multitude of its connections are in a normal condition of health.

In no country has the practical application of Bárány's discoveries been more vigorously followed up than in the medical schools of the United States. That has been particularly the case in the University of Pennsylvania, where Dr. Isaac H. Jones holds the post of instructor in "neuro-otology," and at the same time acts as laryngologist to the Philadelphia General Hospital. In the work under notice Dr. Jones not only introduces his readers to the latest teaching regarding the functions and connections of the labyrinth, but also adds certain discoveries of his own. He claims that the nerve-fibres from the external or horizontal canals pursue a separate course and form different connections in the central nervous system from the fibres which issue from the vertical canals—the superior and posterior. The section of this book in which Dr. Lewis Fisher gives an analysis of a great number of cases where a defect had occurred in the balancing mechanism of the body will prove of particular interest to clinicians. Of more immediate importance are the chapters devoted to a description of the tests applied to candidates for the aviation corps, for it is manifest that a sound and sensitive equilibrating mechanism is as necessary for a flying man as for a bird. The essential tests are based on Bárány's discoveries.

Dr. Jones does not touch on the very interesting problem of how two functions so different in nature as are those of balancing and of hearing became associated in the same organ, nor is our knowledge sufficiently complete to permit us to tell the story in full. Yet from a double source—from the evidence of embryology and of comparative anatomy—we know for certain that the internal ear was evolved as a balancing mechanism—as a sense-organ to provide the body with a knowledge of its position and of its movements—and that the part which serves the function of hearing is a comparatively late addition or extension. In making that addition Nature introduced no new principle, but by a slight modification of the apparatus used for registering changes in the position of the body she evolved an instrument for the registering of sound-waves and for their conversion into nerve stimuli. The basal design of the labyrinth is a minute closed sac filled with fluid. On its floor is a carpet of cells bearing cilia; on the cilia is poised a load. The slightest change in the position of the body of the animal is accompanied by a change in the position of the load and a bending of the cilia. In a manner which we can only guess, the mechanical bending of the cilia is converted by their basal cells into nerve stimuli. For the detection of bodily movements, part of the closed sac became converted into semicircular canals, and across each

canal was drawn a barricade of cilia, also loaded. The canals are so set that a displacement of the fluid within them accompanies every movement, the rate of the displacement being registered by the barricade of hair-cells set across their lumina. By the introduction of a few modifications an area of hair-cells was exposed to displacements of fluid set up by the impact of sound-waves.

Physiologists are only beginning to realise that Bárány's researches on the action of the balancing part of the labyrinth are at the same time throwing a novel light on the nature and action of its cochlear or auditory part. The machinery and the manner in which the machine works are the same in both cases—that of registering a mass displacement of the contained fluid. The evolutionary story of the ear, so far as we know it, is dead against any part of the cochlea acting as a resonator. A. KEITH.

MILITARY GEOLOGY AND TOPOGRAPHY.

Military Geology and Topography: A Presentation of Certain Phases of Geology, Geography, and Topography for Military Purposes. Edited by Herbert E. Gregory. Prepared and issued under the auspices of the Division of Geology and Geography, National Research Council. Pp. xv+281. (New Haven: Yale University Press; London: Oxford University Press, 1918.) Price 5*s*. 6*d*. net.

THIS work is essentially a text-book, prepared with the primary intention of helping in the teaching of the elements of geology and geography to those about to take commissions in the Army of the United States. Throughout it aims at teaching first principles, avoiding technical terms so far as possible.

The first chapter gives an epitome of the types of rock on the earth's surface, with such details as are of interest to the engineer. This is followed by a few pages on earth movements, with excellent diagrams of the effects of faulting, etc. The space allotted to this subject is so restricted that only the most general outlines can be given. The chapter ends with a "summary of engineering considerations related to rocks." Chap. ii. deals with rock weathering, explaining how the strata mentioned in the previous chapter became altered when exposed to atmospheric agents. The next three chapters deal respectively with streams, lakes, and water supply. Most of the information contained in these chapters is such as should be known by everyone who expects to live or journey beyond a city where water is merely obtained by turning a tap and disposed of by means of drains.

Under the heading of water supply several pages are given to military requirements. In dealing with the volumes of water required by an army the demands from all sources—men, horses, washing, etc.—are added together and divided by the number of men in the unit; the result is then given in gallons per soldier. The figure 10–50 gallons per day per soldier is thus arrived at. A point which is not brought out is that a distinction can often be drawn between water for horses and water for human consumption. Emphasis is rightly laid on the importance of the time-factor in military water-supply schemes. Schedules for entering up details of wells, springs, etc., given on pp. 152–56, are those in use by the United States Geological Survey, and therefore have the advantage of having been tested by actual use.

Chap. vi., on land forms, gives, with the help of excellent small diagrams, a good introduction to the study of the relationship of geological structure to the topography of an area. At the end of the chapter is a page of military problems. These are good in showing how geology should be considered in conjunction with other details of a military nature. Unfortunately, only a very small space is devoted to this side of the subject.

Chap. vii. will be found useful in the teaching of map reading and map interpretation. The chapter deals with topographical, and not geological, maps, but shows how the general geological structure of an area can often be foretold by a study of the topography. The book ends with short notes on various minerals, with special reference to their uses in war.

The work throughout is designed for teaching, and it is in some ways unfortunate that it bears the word "military" in such prominence, for the book will be found to be of value to all who wish to have some of the everyday practical applications of geology put before them in an elementary way, or to those who desire a well-illustrated text-book for teaching purposes. From the military point of view it should be noted that the book is designed to help all officers to understand the elementary facts regarding the ground on which they are, or expect to be, fighting. No mention, however, is made of the need for a special geological section of the Engineers composed of experts who can have access to published works and maps, and be in personal touch with men who have worked in the area. There is no doubt that much time and energy would frequently have been saved during the war if all officers had known the principles set forth in this book. It should be borne in mind that unless expert advice is obtained for the larger engineering undertakings, the little knowledge which is a dangerous thing may lead to the starting of impracticable schemes. W. B. R. K.

OUR BOOKSHELF.

A Century of Science in America. With Special Reference to the "American Journal of Science," 1818–1918. By Edward Salisbury Dana and Others. Pp. 458. (New Haven: Yale University Press; London: Oxford University Press, 1918.) Price 17*s*. net.

THOUGH the "prefatory note" makes no mention of the fact, this handsomely produced work appears to be a reproduction for the library-shelf of the number of the *American Journal of Science*

issued in July, 1918 (see NATURE, vol. cii., p. 50). The numerous portraits of American men of science give it distinction, and Clerk Maxwell, Huxley, and Charles Darwin are also represented. It is not stated that the portrait of Huxley is from Collier's famous painting. Some of the articles, as previously noticed, cover the progress of a particular science in the world at large during the century commemorated, 1818–1918.

The *American Journal of Science* originated in the widely cultured mind of Benjamin Silliman, professor of chemistry and mineralogy in Yale College, New Haven, and it is natural that from the first it had as "a leading object" the illustration of "American natural history, and especially our mineralogy and geology." Silliman was fortunate in having James Dwight Dana as a son-in-law, and to this day men of science throughout the world look to the *American Journal of Science* for the publication of original researches on such subjects as fossil reptiles, coral-reefs, and especially synthetic mineralogy. This memorial volume appeals, then, particularly to the geologist, who will find that half its pages are devoted to subjects with which he has some direct acquaintance. It will, moreover, supplement the various published summaries of the history of chemistry, physics, zoology, and botany by bringing into prominence the happy flow of communications that has moved in both directions across the Atlantic during the past hundred years of human thought and observation.

G. A. J. C.

La Genèse de la Science des Cristaux. By Hélène Metzger. Pp. 248. (Paris: Félix Alcan, 1918.) Price 5.50 francs.

THIS is a history of the science of crystals during the seventeenth and eighteenth centuries—that is, during the period of its origin and early development. The earliest serious attempts at a study of crystalline forms were those of the Dane, Nicolaus Steno (1669), and M. A. Cappeller (1723), but the first real advance was made by the French crystallographers, Romé de l'Isle (1772) and the Abbé Haüy (1784). Many quotations are given from the old authors, and their theories and quaint ideas are compared and commented upon. In different sections the subject is considered in its relations to (1) mineralogy, (2) biological sciences, and (3) physical sciences. Although the formation of snow and ice crystals and the growth under the microscope of crystals from mineral waters and saline solutions attracted much attention during this period, the study of crystals has always been more intimately associated with mineralogy. The book concludes with a long list of authors quoted, and a more or less complete bibliography, in which there are several misprints. A rather discursive table of contents takes the place of an index, and, as is often the case in French books, there are no head-lines to the pages. The author is a member of the French Mineralogical Society, and has contributed to its Bulletin under her maiden-name of Bruhl.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Cultivation of Sponges.

THERE appeared in NATURE of April 20, 1916, an abstract of an article by me on sponge culture which was published in the *West Indian Bulletin* towards the end of 1915. In this article an account was given of Moore's work in Florida, and of a more recent commercial undertaking at the Caicos Islands, in which marketable sponges had been reared from cuttings on cement discs in comparatively shallow sea-water.

This interesting, and alleged highly profitable, industry is now attracting serious attention in the Bahamas, where there has been considerable depletion of the natural beds. Farther south, in the Lesser Antilles, the Imperial Department of Agriculture for the West Indies, with which I am connected, has been trying for some time to arrange sponge-growing experiments at islands like Antigua and Barbados, where, even though the locally occurring sponges are of inferior quality, suitable conditions may be found for growing introduced types of better quality by the culture method.

The uncertainty of our knowledge concerning the behaviour of sponges amid different environments, and the paucity of our knowledge of West Indian sponges and their distribution, make a proper scientific inquiry into sponge culture very desirable. Moreover, the prevailing scepticism in certain quarters regarding the profitable character of sponge culture calls for a technical report on the economic side.

At present steps are being taken with the view of securing two marine zoologists for the British West Indies; one of them may be attached to the staff of the Imperial Department at Barbados, and the other will probably be stationed in the Bahamas. It seems, however, that some considerable time will elapse before anything is definitely settled, and even then the investigation of a subject like West Indian sponges and their culture requires careful planning and special qualifications on the part of the observers.

When in London recently I took the opportunity of bringing the matter before Dr. Harmer at the British Museum (Natural History) and Prof. Dendy at King's College. There can be no objection to stating that these authorities consider that sponge culture in the West Indies presents problems of great scientific interest, and they suggest that the inquiry might well be pushed from the purely scientific aspect. It is obvious to the least imaginative that a study of sponges along the West Indian chain through 20° of latitude (1200 miles), and including environmental experiments with different types, would be most valuable. Prof. Dendy is of opinion that the inquiry is worthy of a special expedition, for we know very little about West Indian sponges in this country.

It is intended to bring these views to the notice of the Colonial Office, and to submit that an official application for financial assistance and scientific guidance should be made to the Department of Scientific and Industrial Research. Suggestions as to any other steps desirable will be appreciated.

In concluding this letter, it may be pointed out that during the war, owing to the naval occupation of the Mediterranean, this country has been largely dependent upon the West Indies for its supply of sponges, which are essential to a large number of important

industries. We can keep this increased trade only if we maintain West Indian production and, what is quite as urgent, improve West Indian grades so that they can compete with the Mediterranean. This may or may not be achieved by means of sponge culture, but it is worth trying. The Americans have undoubtedly made progress with sponge culture in Florida, and a significant fact is recorded in a recent British Colonial Report on the Turks and Caicos Islands to the effect that at one of these islands 8000 acres of sea for sponge culture has been conceded to a capitalist from New York. While we should prefer to see British enterprise of this nature, particularly in a British Possession, we have to recognise a certain consistency in United States action. Most of the marine investigation in the West Atlantic has been American; for instance, Prof. Nutting's recent and former expeditions, the study years ago on the fishes of Porto Rico by the U.S. Government, and the quite recent oceanographic work in the steamer *Bache*. It is to be hoped that Great Britain will see its way to take up the sponge question, first from the scientific, and then from the commercial, point of view, and that a start will be made at the earliest possible date. W. R. DUNLOP.

Seaholme, Hythe, Kent, April 23.

Wasps.

THE warm spring weather which made its advent on Good Friday (April 18), and was continued on following days, brought out numbers of humble-bees, a few wasps, and butterflies of various kinds. I have usually observed that the humble-bees precede the wasps by a week or two.

A wasps' nest (*Vespa germanica*) situated in the garden here in 1915 was a rather strong one, and on digging it out in October I estimated the number of cells as 12,900. A nest of the same species which I had in 1918 was much stronger. In 1915 the hourly number of wasps flying in and out of their nest was 6500 at the most abundant period, while in 1918 the rate was no fewer than 15,500. The record heavy rains of September last, however, swamped the nest and brought it to a premature termination, when but few of the young queens had taken to flight. If the nest of 1918 had a number of cells proportionate to that of 1915, according to the hourly rate of wasps flying to and fro, then the total number of cells must have been about 30,000; but I prefer to take a more moderate estimate, and to put the aggregate at 25,000. I could not, however, actually determine the number by observation, the layers of comb being so soaked with the wet that they did not admit of detailed investigation. If each cell produces three generations of wasps, then my nest of 1918 must have been responsible for quite 75,000 wasps. Needless to relate, house-flies were not troublesome in this neighbourhood during last summer! But which pest of the two, wasps or house-flies, is the more tolerable? For my part, I greatly prefer the wasps!

Can any reader inform me as to the number of wasps supposed to be associated with a very strong nest? W. F. DENNING.

Bristol.

THE LUNAR TIDE IN THE ATMOSPHERE.

TIDAL theory was first applied with any success to the atmosphere by Laplace, and he also first attempted to determine the tidal variation of pressure from barometric observations. His material consisted of 4752 measurements of the height of the mercury column at Brest (lat. 49° N.). These were far too few for the purpose, however, and his result, given in tome v. of the "Mécanique Céleste," cannot be regarded as a determination of the quantity sought for, which is much smaller than Laplace's value. Another lunar reduction of barometric data from Brest was made about thirty years ago by Bouquet de la Grye, but his series of observations (consisting of hourly values extending over a few years), while larger than that used by Laplace, still seems to have been inadequate. He arrived at a lunar daily inequality of pressure which was not by any means nearly semidiurnal in type, though the semidiurnal component—$0{\cdot}020 \sin(2t+100°)$ mm. of mercury—was larger than the probable true value of the tidal variation at Brest.

The atmospheric tide was determined from a *tropical* series of barometric records so early as 1847. There now exist more or less trustworthy determinations for five tropical stations—St. Helena, Singapore, Samoa, Hong-Kong, and Batavia. The results for the two last are from long series of hourly observations, extending over thirty or more years, and are therefore of considerable accuracy. Though the tidal barometric variation has its maximum value at the equator, its magnitude there is very small. At Batavia (6° S.) it may be represented by the formula

$$0{\cdot}065 \sin(2t+65°) \text{ mm. of mercury,}$$

where t denotes time reckoned from lunar transit at the rate of 360° per lunar day. The phase angle 65° indicates that maximum pressure occurs nearly an hour after the moon crosses the meridian.

Until recently the only determination of the tide which could be considered as probably an approximately true one, among the results for extra-tropical stations, seems to be that obtained by Morano from five years' hourly barometric observations at Rome (42° N.). Though the series of data was not large, the resulting amplitude and phase agree with what might be expected in this latitude. Many other attempts to determine the tidal barometric variation in European latitudes have been made without success. The most important of these investigations was due to Airy, who dealt with as many as 160,000 hourly observations of the barometer at Greenwich (51° N.), ranging over the twenty years 1854–73.

The barometric pressure is affected by a solar semidiurnal variation as well as, and of much greater amplitude than, the lunar tidal variation. Unless the former is properly abstracted from the hourly values before deducing from them the lunar inequality, the determination of the latter may be seriously affected by a residuum of the solar term. Two other causes operate to enhance the difficulty of detecting the lunar variation in the barometric records of stations in moderate and high latitudes. The first is the rapid diminution of the tidal amplitude as the latitude λ increases. The second is the increase in the irregular fluctuations of the pressure. At Brest or Greenwich these range over several millimetres (of the mer-

cury column) in the course of a day, far exceeding not only the lunar, but also the solar, diurnal variation.

Even after abstracting the latter periodic oscillation from the hourly values, the elimination of the irregular changes requires the use of a large amount of observational material. Airy's discussion shows that even twenty years' data might prove insufficient. The Greenwich records of atmospheric pressure now extend over sixty years, but this threefold enlargement of the available material does not by itself ensure very much reduction in the accidental error affecting the determination. Hence, in attempting a new investigation, improvement was sought by excluding all but relatively "quiet" days from its scope, on the ground that the diminution in the number of days used is outweighed in advantage by their better quality for the purpose in hand. Rather lunar diurnal inequality of pressure to be deduced. Wherever possible, simplifying devices were used in computation, and the solar diurnal variation was duly removed from the data to rid the results of this important source of error.

The accompanying figure (taken from the Q.J. Roy. Met. Soc., vol. xliv., p. 271, 1918) represents the mean lunar daily inequality of atmospheric pressure which was finally obtained. The unbroken curve, which is almost entirely semidiurnal, as tidal theory would predict, is the one deduced from the observations (the inner two vertical lines mark out a complete lunar day, on either side of which a small portion of the curve is repeated); on harmonic analysis its semidiurnal component proves to be

$$0{\cdot}0090 \sin(2t + 114^\circ) \text{ mm. of mercury,}$$

represented in the figure by the broken curve.

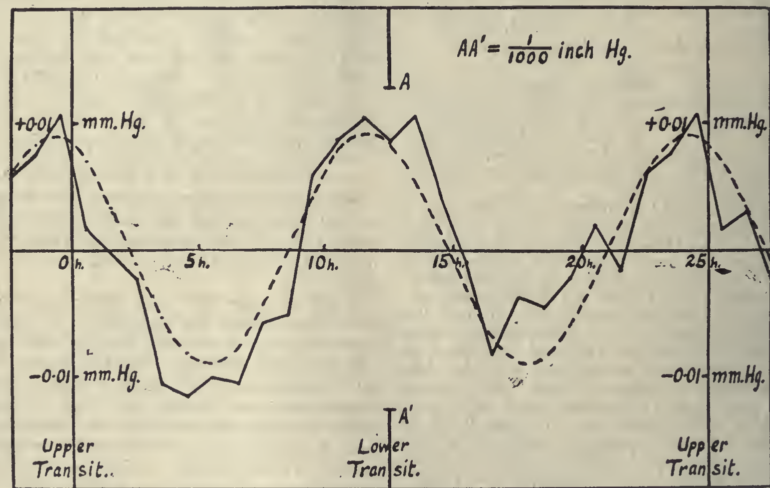

FIG. 1.—The lunar semidiurnal tide in the atmosphere at Greenwich, as determined from the Greenwich Records of Barometric Pressure, 1854–1917.

less than one-third of the whole number of days in the sixty-four-year period 1854–1917 were retained, being those on which the range of pressure did not exceed 0·1 in. The hourly values consequently totalled about 160,000, as in Airy's work.

There are approximately twenty-five solar hours in a lunar day, so that the twenty-four-hourly values on each "quiet" solar day were supplemented by the last hourly value on the preceding day. Each such series of twenty-five observations was broken into two parts, preceding and following the lunar transit on the day in question. The preceding portion was transposed so as to succeed the other, in order that the rearranged series might correspond with intervals of, in the average, $0\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, . . . $24\frac{1}{2}$ solar hours after lunar transit. These series were written in rows, and the numbers in each hourly column were then added up, so as to enable the mean

The whole range of this, in inches, is 0·00071, appreciably less than one-thousandth of an inch (indicated in the diagram by AA′). The original observations were made to 0·001 in. of mercury (from a photographic record giving a fourfold magnification); in the computations, however, the last figure in each hourly value was omitted (the previous digit being raised when necessary), the entries on the lunar sheets being made to 0·01 in. only. In the circumstances, considering the (relatively) large irregular changes of pressure, even on these "quiet" days, it is somewhat remarkable that so small a variation can be detected so clearly.

In such an investigation it is needful to guard against obtaining a fictitious result which merely happens to be of semidiurnal type. This point may be tested by subdividing the data and examining the internal agreement of the results from the

separate sub-groups. In the present case the sixty-four years were divided into three periods, 1854–73, 1874–93, 1894–1917; the semidiurnal components obtained by analysis of the three corresponding mean hourly inequalities of pressure were, in mm. of mercury,

$$0{\cdot}0080 \sin(2t + 96^\circ)$$
$$0{\cdot}0089 \sin(2t + 112^\circ)$$
$$0{\cdot}0104 \sin(2t + 127^\circ),$$

between which there is sufficiently satisfactory accordance.

On comparing the determinations for Batavia and Greenwich it appears that the amplitude of the lunar atmospheric tide varies approximately as $\cos^4 \lambda$, where λ is the latitude. At Greenwich the tide is nearly an hour in advance of the moon, whereas at Batavia the order is reversed. It is possible that the amplitude and phase are subject to some modification from local causes. The fact that the observed tide is larger than the equilibrium tidal theory would predict may be attributed to the occurrence of resonance with a free period of atmospheric vibration of rather shorter duration. But, as Laplace suggested, the rise and fall of the oceans may also be partly responsible for the observed tide, and, if so, some differences might be expected between the results from oceanic and continental stations in the same latitude. The lunar tidal range of pressure is equivalent to the weight of a column of air of normal density of height 4·4 ft. at Batavia and about 7 in. at Greenwich. Hence in northern latitudes quite a small tide, existing over a considerable area, might suffice to affect the tide in the atmosphere to an appreciable degree.

S. CHAPMAN.

INTER-ALLIED CO-OPERATION IN CHEMISTRY.

INTER-ALLIED co-operation in chemistry, of which a brief notice appeared in NATURE for April 24, should be of interest to all men of science, for what is true of chemistry is very largely true of all branches of science. Men of genius have developed in all countries, and of the really important scientific discoveries the Allies have contributed at least their due proportion, if not more. But the total volume of scientific work turned out by Germany during the last fifty years has been immense, and in the application of scientific discoveries to chemical manufactures the Germans have been easily first. Moreover, in the laborious and useful work of abstracting, indexing, and publishing, the Germans have displayed their usual methodical industry; and they have not by any means under-estimated their achievements, or neglected to give them world-wide advertisement.

A good deal of antipathy to Germans and German ways now prevails, especially in those countries which have experienced German methods of devastation. French chemists and chemical manufacturers can scarcely be expected during this generation to co-operate in any way with their eastern neighbours, and they have invited the Allied chemists, pure and applied, to join them in undertaking a mass of work which hitherto has been done, and, on the whole, well done, by Germany. In chemical matters there has been during the war a considerable amount of real co-operation between the Allies. The French, Americans, and British have been of great help to each other in solving chemical problems, both of research and manufacture. It is felt that the Allies will all gain by continuing, so far as is possible, the co-operation thus begun.

Prof. Moureu presided over the recent conference in Paris, and among his French colleagues were Profs. Haller, Béhal, and Matignon, MM. Kestner, Poulenc, Marquis, and Gérard. The British delegates were Prof. Louis, Sir William Pope, Messrs. Chaston Chapman, W. F. Reid, E. Thompson, and S. Miall. America was represented by Mr. Henry Wigglesworth, Lt.-Cols. Bartow, Norris, and Zanetti, Dr. Cottrell, and Major Keyes; Italy by Senator Paternò, Drs. Pomilio, Giordani, and Parodi-Delfino; and Belgium by MM. Chavanne and Crismer.

It was unanimously decided to form an Inter-Allied Federal Council of not more than six representatives of each of the countries mentioned above, the members to hold office for three years, one-third to retire annually and be eligible for re-election. The executive body is to consist of a president, a vice-president, and a general secretary. M. Jean Gérard will provisionally act as the secretary. In addition to the council a consultative committee will be formed, consisting of as many sections as may be necessary to secure the complete representation of pure and applied chemistry. The objects of the confederation are: To strengthen the bonds of esteem and friendship existing during the war between the Allied peoples; to organise permanent co-operation between the associations of the Allied nations; to co-ordinate their scientific and technical resources; and to contribute towards the progress of chemistry in the whole of its domain.

Neutral countries may be admitted later. The next meeting of the conference will be held in London on July 15–18, that being the date of the annual meeting of the Society of Chemical Industry.

So far as Britain is concerned, the choice of representatives and the supervision of the arrangements for the first meeting will be in the hands of the Federal Council for Pure and Applied Chemistry, of which Sir William Pope is president and Prof. H. E. Armstrong the honorary secretary. Until the various nations concerned have chosen their representatives, little can be done, but Sir William Pope and Prof. Louis are provisionally acting as the British representatives, and are in communication with their French colleagues.

The meeting in Paris was held under the auspices of the French chemical societies, especially the Société de Chimie Industrielle, the president of which, M. Paul Kestner, presided at some

of the meetings. The final meeting of the members of the conference was held at the Palais d'Orsay at a banquet presided over by M. Loucheur, the Minister of Industrial Reconstruction, at which Lord Moulton was also present.

During the meeting of the conference some interesting papers were read. Prof. H. Louis gave an excellent summary of the magnetic concentration of poor iron-ores, a subject of special importance to our Allies at the present moment.

Dr. F. Cottrell reported fully on the recent production of helium in the United States, describing the new plant which has been erected in the U.S.A. for the freezing of gases by the cylinder-expansion process. Helium is one of the most recent and best illustrations of the co-operation of science and practice. First detected in the sun by Sir Norman Lockyer by means of its spectrum, and afterwards found in the earth by Sir William Ramsay, it was detected in gases from subterranean sources by various observers, especially by Prof. Moureu, who published his results in the *Annales de Chimie* in 1915 and 1916, and gave some further particulars of his researches in the discussion on Dr. Cottrell's paper. At the commencement of the armistice the practical work done in the United States, following that carried out in connection with the British Admiralty Board of Invention and Research (see NATURE, February 20), had resulted in the accumulation of a large quantity of helium, which is now available for other than warlike purposes.

On April 16 many of the delegates visited the devastated region of Chauny, Tergnier, and St. Gobain. This is classic ground for the chemist, as it was here that the Leblanc soda process was first installed on a large manufacturing scale, and the Gay-Lussac tower was also originated there, its inventor being a director of the St. Gobain Company. The date, 1665, on the ruined portal of the glass factory shows its antiquity. The ruin wrought by the invaders was systematic and complete; in the villages not even the humblest cottage remained uninjured, and what was an industrious and prosperous community has been totally ruined: let us hope for a short time only.

The Inter-Allied Council has a big task in front of it, and the first thing will be for the various members of the council and committees to get to know each other. Not only has the work to be done, but the right men have also to be chosen to do it. It will be some time before the different nations, speaking different languages and looking at matters from different points of view, can so organise themselves that they can accomplish their task smoothly and efficiently. But the goodwill and determination which exist should be sufficient to enable them to achieve success. The various chemical societies in this country will no doubt communicate their wishes and ideas to the Federal Council, and by the end of this summer it should be possible to put forward some practical scheme and a carefully considered programme.

THE ROYAL ACADEMY.

A VISIT to the Royal Academy cannot fail to be of interest to those who take pleasure in the ways of Nature, the varying moods of which are shown in so many of the pictures exhibited. Unfortunately, it has to be admitted that while there is much of interest to the scientific worker in each year's exhibition, there is also much that is jarring by reason of its lack of adherence to the truth. So much adverse comment is passed upon the works of the exhibitors by artistic critics at the opening of the exhibition each summer that it is perhaps natural for artists to make greater efforts to meet this criticism than a purely scientific criticism, which in general, though well deserved, remains unvoiced. To the man of science no result can be pleasing which is produced merely for the sake of effect and in its production overrides the laws of Nature. As an example of this type may be cited "Off the Western Land" (198) in the exhibition which opened at Burlington House at the beginning of the present week. It is difficult to believe that the combination of colours there depicted on the sea and in the sky could ever be approached in Nature. In the same way the colouring of the clouds in "The House on the Sea Wall" (309) cannot be passed over without comment. The complete semicircular rainbow in "Passing Storm" (232) seems to be independent of the presence of raindrops in its formation. While rain is seen to be falling in one part of the sky, the artist appears to have gone out of his way to indicate that there is no rain in another part of the bow, the cumulus cloud behind showing up with absolute clearness.

A study of the landscapes in successive exhibitions reveals the fact that an artist may often be known by his clouds, just as surely as by the type of country which he chooses for his subject. The typical cloud in a Leader is the soft cumulus, always produced with admirable effect. Arnesby Brown is another whose works may readily be distinguished by the cloud forms depicted, though the meteorologist is not always able to pass an entirely favourable verdict upon the result. The cloud effect in "A Village by the Sea" (96) by this artist deserves, however, its meed of praise. Peter Graham's mountain scenes generally show patches of mist amongst the hills, while this year, in "A Shower across the Hills" (150), falling rain has been introduced with a very pleasing result. A study of the fairly numerous pictures in which a portrayal of rain is attempted leads to the conclusion that the subject is far from an easy one to treat successfully. In "By the Woodside" (H. Sylvester Stannard, 673) an unpretentious but natural sky showing through the trees adds much to the success of the picture. Snow scenes have attracted an unusually large share of attention in this year's exhibition, and they are generally dealt with successfully. In "Through the Woodland Snow" (J. Farquharson, 19) the soft, moist look

of the snow which half covers the ground allows of no other conclusion than that a thaw has set in, and that the snow covering will not long remain. In "Day Departing in the West" (171) the same artist has another attractive snow picture. There is a curiously unnatural appearance about "The Bathers' Pool" (765). Here a sandy beach is depicted, but the sand, instead of sloping gently to the sea, is cut away in an almost vertical "cliff" at the water's edge, the face standing at an angle which looks most unreal.

The sea scenes which appear in numerous pictures call for little comment, and, though some are pleasing, few are of outstanding excellence. In this branch of painting, the gap left by the death of C. Napier Hemy seems to remain unfilled. Now that the scientific spirit is beginning to permeate the world, and is no longer confined to a few specialists, it may be hoped that artists will come to realise that a true representation of Nature may be not inconsistent with the highest artistic success, while a travesty of Nature must fail to satisfy a large and growing section of the general public.

J. S. D.

ROBERT CHAPMAN DAVIE.

Of the sad fates that have befallen so many who have helped to win the war for us, the succumbing to an attack of influenza on return home after years of physical hardship in the war zone is of the saddest. That has come to Capt. Robert Chapman Davie, R.A.M.C., a botanist from whom much was expected as teacher and researcher. Capt. Davie crossed the Channel on his way home on January 25, was attacked by influenza two days later, and after a week's struggle died of pneumonia at Largs on February 4.

Born in Glasgow thirty-two years ago, Davie was educated at the Glasgow High School and at the University of Glasgow, where he graduated M.A. in 1907, obtaining a first class in English literature. Later, in 1909, he took the degree of B.Sc., distinguishing himself particularly in botany and in chemistry. In botany he was Dobbie-Smith gold medallist and also Donaldson research scholar. Whether botany or chemistry was to attract him for his life-work he had difficulty in deciding. The enthusiasm of his botanical teacher, Prof. Bower, finally determined his devotion to botany, and he became an assistant in the botanical department of his *alma mater*. In 1912 Davie migrated to fill the post of assistant in the botanical department of the University of Edinburgh, and in 1913 he was appointed lecturer on botany in the University. In 1915 he graduated D.Sc. of the University of Glasgow. His appointment a couple of years ago as one of the secretaries of the botany section of the British Association pleased him greatly, and was an apt choice of a man with much business capacity and wide botanical knowledge. An attack of rheumatic fever in early life had somewhat undermined his health, causing him frequently some heart trouble, and in consequence of this he was able to join the Army only in 1917 to fill a post where scientific knowledge rather than physical endurance was required, and he was at the time of his death senior chemist in the 4th Water Tank Company in France.

A prominent characteristic of all that Davie did, whether as teacher or as researcher, was that of precision, and his literary gifts enabled him, alike in the lecture hall and in his writings descriptive of his scientific research, to present his facts and arguments with a fluency of diction and a grace of style that ensured lucid exposition. His chief research was in the domain of the Pteridophyta, a natural consequence of his upbringing in the home of work in the group under Prof. Bower. An investigation of the East Asiatic ferns of the genera Paranema and Diacalpe was his first essay (1912), and in the course of settling disputed points of their relationships he entered the controversial field of the "fern stele and pinna-trace," wherein he reaped largely then and also later, carrying on his line of research from the ferns, through the Cycads, into the Angiosperms.

Davie's grouping of the ferns by the form of the leaf-trace in his last paper, published so recently as 1918 during his absence, is essentially in harmony with groupings to which Prof. Bower and others had been led by analysis of other characters, and shows that amidst the laborious examination of the dry bones of anatomy Davie's research was inspired throughout by thought of origins and adaptations. How, why, when, are its keynotes, and the facts, bald statement of which as evidence of difference or likeness satisfied many of the older writers on the same subject, interested Davie solely from the point of view of interpretation. This attitude finds expression in his most important paper—delayed in publication through the manuscript having been destroyed by a fire at the printers', and having to be rewritten—in an interesting analysis of the relative degree in which phyletic factors and those of specific adaptation have been operative in bringing about the forms of leaf-trace development in connection with water supply in plants. If the precision of his mind led him at the moment to segregate factors in the several groups and classes of vascular plants with a definiteness of generalisation which addition to the few data as yet available outside the ferns may show to require modification, the attempt and its methods are suggestive, and, carried further, as was his intention, must, in his hands, have thrown much light upon the proper appraisement of the value of anatomy in questions of obscure relationships of the higher plants, and given clues helping to the understanding of their phylogeny in relation to cosmic history.

On removal to Edinburgh, Davie took up the study of the Proteaceæ from the phyletic point of view; their conjectured relationship to Leguminosæ fascinated him. Assisted by a grant from the Royal Society, he spent some months of 1914 in Brazil making observations and gathering material, especially of Roupala, which, through its

heterophylly, promised enlightening information on the subject of the leaf-trace. Beyond an account of plants other than Proteaceæ which he had collected, Davie had not been able to complete the record of the results of his exploration. Alert in body and in mind, keen and undemonstrative in his work, thorough in everything, Davie gave promise of taking a prominent place amongst those upon whom rests the responsibility of scientific education and of extending the boundaries of science. Botany loses in him a talented and devoted adherent.

NOTES.

ON Friday, May 2, the Animal Anæsthetics Bill passed its second reading in the House of Commons. The object of this Bill is to insist on the use of anæsthetics in a large number of cutting operations on horses and dogs. The operations to which the Act should apply are specified in a schedule to the Act, in which a distinction is drawn between those which should be performed under general anæsthetics and those for which a local anæsthetic is required. It is worth noting that the Act does not apply to farm animals, on which operations for the improvement of their market value can continue to be performed without anæsthetics. Of the legislators who have been prominent in endeavouring to suppress experiments on animals performed with a view to prevention of human disease and suffering, we notice only the name of Sir J. G. Butcher as taking part in the discussion or supporting the Bill—another proof, if proof be needed, that the leading motive in these people is not kindness to animals or regard for their fellow-creatures, but opposition to the advance of science in general, and in our knowledge of the processes of life in particular.

IN the House of Commons on May 2 the Bill to control the importation of goods infected, or likely to be infected, with anthrax, and to provide for the disinfection of any such goods, was read a second time. Sir Hamar Greenwood, in moving the second reading, outlined the incidence of anthrax in this country and the findings of the Anthrax Committee. The Bill contains two principal provisions. It gives power by Order in Council to prohibit the importation of goods infected or likely to be infected, either absolutely or except at any specified ports, and it empowers the Secretary of State to provide and maintain the necessary works for the disinfection of goods. It is also likely that, under the auspices of the League of Nations, international action may be taken with a view to the control of anthrax.

IN the course of a discussion in the House of Commons on April 30 upon the subject of agricultural policy, the Parliamentary Secretary to the Board of Agriculture announced that the Government has decided to appoint a Royal Commission forthwith, and that all parties materially interested will be represented. He pointed out that a quick report is needed to enable the Government to frame a policy in the next few months. This may be obtained by an interim report on the more important branches of agriculture. It must be ascertained what guaranteed prices are necessary in order that, while good wages are paid, the industry is in a position to pay them. With such guarantees the farmer will have some idea of his economic position during the next few years which he has lacked during the past.

AEROPLANES waiting at St. John's, Newfoundland, for the Atlantic flight are still weather-bound, and, so far as can be judged from information issued as we are going to press both by the Meteorological Office and by the Air Minstry, there are storm areas in the Atlantic over a considerable portion of the route which would be followed in the flight. So far as possible choice should be made of a period at which the Atlantic high-pressure area is centred over the Azores, when for the route eastwards the winds would probably be westerly and generally of no great strength; the disturbances so commonly travelling eastwards would, under these conditions, be pushed to the northwards by the region of high barometer. However unsatisfactory it may be to get no wireless information from ships over the Atlantic, it seems much more unsatisfactory to contemplate starting without such information, since the chances of bad weather greatly preponderate. Settled weather on the western and eastern sides affords no idea as to the weather in mid-ocean. Under the auspices of the United States naval authorities, Curtiss seaplanes are now being entered for the Atlantic flight. It is intended to span the Atlantic by a succession of "hops." The start had been timed for the early part of this month, flying from Long Island to Halifax, thence to Trepassey, Newfoundland, and with fair conditions it was hoped to leave Trepassey for the Azores within ten days of the start from Long Island, and Lisbon was to be the next stop. A report in the *Times* of May 6 from New York says: "On the eve of their departure for Newfoundland two of the American trans-Atlantic seaplanes were seriously damaged by fire."

THE Army Medical Department announces the institution of two new appointments—a Director of Pathology and a Director of Hygiene. According to the *Times*, it is understood that Sir William Leishman is to be nominated to the former and Sir William Horrocks to the latter. The object of the scheme, which originates with the Director-General, Sir John Goodwin, is "to link up under a definitely planned organisation the activities of the different departments and individuals hitherto concerned with the various problems of preventive medicine, pathology, and tropical diseases bearing upon the health of the Army in peace and war." Advisory committees are to be set up in each directorate, consisting of the Director as chairman, a deputy director, and the following members:—*Hygiene:* The professor of hygiene at the R.A.M. College, a representative of the War Office and of the Directorate of Fortifications and Works, a sanitary engineer, a civil professor of hygiene or medical officer of health of a county or large city, a physiologist, and a representative of the Local Government Board. *Pathology:* The professors of pathology and of tropical medicine at the R.A.M. College, two civilian pathologists, a civilian professor or expert in tropical medicine, and a representative of the Medical Research Committee. The scheme is a thorough one, and should increase the efficiency of the Army Medical Department.

THE death of Dr. Edmund Weiss, director of the Vienna Observatory for thirty-two years, occurred so long ago as June 21, 1917, but was not announced to the Paris Academy of Sciences, of which he was a correspondant, until March 24 last. Dr. Weiss was born at Freiwaldau, in Austrian Silesia, on August 26, 1837, but some years of his early life were spent in England, for his father held an appointment as a physician in a health institution in this country. On the death of that relative Dr. Weiss returned to his native land, and, after a course of education at Troppau and the Vienna University, he

was appointed assistant at the observatory in 1858, and on the death of Karl von Littrow in 1878 he succeeded to the directorship, which he held until 1910. In his early years as an observer Dr. Weiss took part in important geodetic work, and retained an active interest in that branch of science, being a prominent member of the International Geodetic Organisation. In 1872 he visited England and North America for the purpose of studying the methods of observatories and optical works, and thereby gained knowledge which was of great value to him; for though von Littrow had the satisfaction of seeing the building of the new Vienna Observatory at Währing begun as the result of his efforts, he did not live to see its completion, and the planning of the equipment was largely due to his successor. Dr. Weiss observed the transit of Venus of 1874 from Jassy, and took part in several eclipse expeditions. He made many contributions to the literature of astronomy through the usual channels on the subjects of comets, meteors, and orbits, besides others of a popular kind. Also he prepared a revised edition of Oeltzen's catalogue of Argelander's zones from 15° to 31° S. declination, published in 1890. Dr. Weiss was elected a fellow of the Vienna Academy in 1878, and an associate of the Royal Astronomical Society in 1883.

DR. PAUL CARUS, the distinguished editor of the *Monist* and the *Open Court*, died on February 11 at his home in La Salle, Illinois, at the age of sixty-seven. Dr. Carus was born and educated in Germany, his father being the Superintendent-General of the Prussian State Church. He studied first at Strasburg and afterwards at the Theological College of Tübingen, where he obtained his doctorate in philosophy in 1876. He went to Chicago in 1887 to become managing editor for the Open Court Publishing Co., an institution founded and richly endowed by his father-in-law, the late E. C. Hegeler. At the outbreak of the war Dr. Carus was notorious for his warm advocacy of the German view of the origin of the war. Yet he lived to rejoice in the defeat of Germany, the development of the conflict having served to enlighten him. His sons fought in the American Army against Germany. Dr. Carus's own writings show a wide and varied scholarship and range over many topics, taking the form sometimes of poetry, sometimes of philosophy. His chief interest was Oriental philosophy and religion, and he pursued it with the ardour of a propagandist. The Religion of Science Library which he founded has made available at a low price a number of religious and scientific books, and also many reprints of philosophical classics. Particularly to be noted are his English translations of Dedekind, Hilbert, Mach, and other distinguished mathematicians and physicists.

THE current number of the Kew Bulletin gives particulars of the career of M. H. Léveillé, who died on November 25 last in his fifty-sixth year. M. Léveillé was for a time professor of science at Pondicherry. He was the founder and permanent secretary of the Académie Internationale de Géographie Botanique, and edited for it *Le Monde des Plantes*, since renamed the *Bulletin de Géographie Botanique*. He was particularly interested in the flora of China, and published, among other works, a "Catalogue des Plantes du Yun-Nan." The same issue of the Bulletin also records the death of Mr. C. K. Bancroft, until recently Assistant Director and Government Botanist, British Guiana. Mr. Bancroft received his early scientific education at Harrison College, Barbados, and was the first to win a natural science scholarship in the West Indies, being awarded the Barbados scholarship in 1905. After graduating at Cambridge he devoted his attention to botany, especially mycology and plant pathology, and worked for a time at diseases of plants in the Jodrell Laboratory. In 1910 Mr. Bancroft was appointed Assistant Mycologist in the Federated Malay States, and three years later was made Assistant Director and Government Botanist, British Guiana, which position he occupied until breakdown in health brought about his resignation.

THE death of Sir Frank Crisp, Bart., on April 29, in his seventy-seventh year, removes from public life an eminent exponent of commercial law, and also a real force in scientific circles. Early in his career Sir Frank Crisp joined the Royal Microscopical Society, and in 1878 became one of its secretaries. He speedily improved the Journal of that body by enlisting the help of experts and publishing abstracts of biological articles, thus rendering a real service to science. He was unsparing of pains or purse, and when in 1889 he was compelled to end his secretarial labours he left the Journal established on a firm basis. Not less noteworthy was Sir Frank Crisp's influence on the conduct of the Linnean Society. From 1879 to the day of his death he served practically continuously on its council, and from 1881 to 1905, a period of twenty-four years, he was treasurer. His quick grasp of essentials, strong common sense, and generous disposition were of the greatest value during his long term of office, and his memory will be cherished as a large-hearted and clear-sighted adviser. His alpine garden at Henley is world-famous.

THE death, on April 30, of Dr. F. J. Smith, honorary consulting physician to the London Hospital, has removed from the medical profession in London one of its best-known and most popular members. Born at Castle Donington, Leicestershire, on August 17, 1857, Dr. Smith was educated at the University of Oxford, where he was a scholar of Balliol, at the London Hospital, and at the Universities of Leipzig and Halle. He was Radcliffe fellow during the years 1885–88. Dr. Smith's professional work lay particularly in the direction of pathology and of medical jurisprudence. In the former subject he paid special attention to diseases of the heart, while in the latter he attained a deservedly high reputation as the editor of the last three editions of Taylor's authoritative text-book. In 1904–6 he was president of the Hunterian Society, and was the orator of the society in 1900.

THE death is announced, at eighty-eight years of age, of Prof. E. Townsend, late professor of engineering and Registrar of University College, Galway.

THE Electrical Research Committee has appointed Mr. E. B. Wedmore as director of research.

NEXT Thursday, May 15, Prof. F. Keeble will deliver the first of a course of two lectures at the Royal Institution on intensive cultivation. The Friday evening discourse on May 16 will be delivered by Dr. S. F. Harmer on sub-Antarctic whales and whalings.

AT a recent meeting of the council of the Marine Biological Association of the United Kingdom it was announced that Dr. G. P. Bidder and Mr. E. T. Browne had each undertaken to contribute a sum of 500*l.* towards a fund for the extension of the laboratory at Plymouth. The new building will be commenced at once, and the scheme, when completed, will provide both a new and larger aquarium and special laboratories for physiological work.

THE British Scientific Research Association is about to appoint an assistant director of research at a salary of 1000*l.* per annum. The person appointed will be mainly responsible, under the director of research,

for the researches arising out of the needs of the electrical scientific instrument, the X-ray, and the electro-medical instrument industries. Applications for the appointment, accompanied by not more than three testimonials or references, must reach the secretary of the association, 26 Russell Square, W.C.1, by, at latest, May 21.

At the meeting of the Institution of Civil Engineers on April 29 H.M. the King of Italy and H.R.H. the Prince of Wales were elected as honorary members of the institution. It was announced that the council had made the following awards for papers read and discussed at the meetings during the session 1918–19:—A Telford gold medal to George Hughes (Horwich), a Telford gold medal and an Indian premium to R. B. Joyner (Bombay), a Watt gold medal to W. S. Abell (London), a George Stephenson gold medal to the Hon. R. C. Parsons (London), a Webb prize to F. E. Gobey (Horwich), Telford premiums to James Caldwell (London), H. B. Sayers (London), J. Reney Smith (Liverpool), and F. W. Scott (Benoni, Transvaal), and a Manby prize to E. L. Leeming (Manchester).

In the March issue of *Man* Mr. A. C. Breton describes some Mexican small clay heads found in great numbers on the site of Teotihuacan. Almost every site in that region has its distinctive type of these little heads. Although much battered and archaic in style, they deserve reproduction for the treatment of the eyes, which consist of double hollows separated by a ridge, with no pretensions to represent the actual eye. Another figure in stone represents a frog, and is apparently a rain-charm, the frog being in Mexico and elsewhere intimately associated with the coming of the rain. In this example the frog is depicted with hands uplifted in a praying attitude, while the tongue hangs out as if with thirst. Mexicans say that the frogs pray for the rain, and in Yucatan the croaking of the large frog is a sure sign of rain within three days.

In the *Rivista Italiana di Sociologia* (vol. xxi.) Prof. Giuffrida-Ruggeri attempts to analyse into its component elements the population of Abyssinia and the Italian colony of Eritrea. He claims that what he calls the "prehistoric stratifications" were composed of small negroes (pygmies), who came from the west and south, and the proto-Ethiopic people. To these were added the "historic stratifications," Semites from Arabia and the "deutero-Ethiopians" or Gallas, who entered the Abyssinian domain in the sixteenth century. Abyssinia may be regarded as an immense fortress or crucible in which these four racial ingredients were mixed. In conformity with the popular dogma of ethnology, Prof. Giuffrida-Ruggeri attempts to associate certain types of culture with the different *races*, ignoring the fact that in the course of the development of any invention it has always happened that the leaven of a new discovery is diffused abroad among the intelligent minorities of other peoples long before it has permeated the unintelligent lump of the bulk of the population in the home of its birth, so that by the time a practice or belief has been definitely shaped it is no longer the property of one "race," but of many peoples. Prof. Giuffrida-Ruggeri attributes the invention of agriculture, hut-construction, and the use of the bow to the primitive negro stratum; and to the proto-Ethiopians the practice of erecting dolmens and monoliths, and the worship of the sun and stars, of fire and water, of trees, serpents, birds, elephants, etc., as well as of the force of fertility. No adequate reasons are suggested for these daring speculations.

The Journal of the American Museum of Natural History (part 1) contains a delightful article on the water-birds of Louisiana, illustrated by some very remarkable photographs. Thanks to very efficient measures of protection, the white egret, until lately the victim of the cruelty and greed of the plume-hunters, is now recovering its numbers, even though it had been reduced to the verge of extinction. The author, Mr. Alfred Bailey, is also able to report that the roseate spoonbill, similarly terribly reduced in numbers by the plume-hunters, is now in a fair way to recovery. Their guardian is an ex-plume-hunter! Finally, this number contains a series of "In Memoriam" articles on the late Col. Theodore Roosevelt, John Burroughs and Prof. H. F. Osborn being among the contributors.

The report of the National Park Board, Tasmania, has just reached us. We gather from it that in 1917 some 27,000 acres were enclosed to form a reservation for the native fauna and flora of Tasmania. Though late in the day, this reservation, if it can be adequately protected against poachers—about which there seems to be some doubt—should perform a very real service to the State and the world at large from the point of view of the man of science. The larger lakes in this enclosure, we are told, have been "restocked with fish. The Fisheries Commission assisted by defraying half the cost of distributing 12,000 rainbow-trout fry." We trust that this experiment will not be at the expense of the native fish, which would defeat the avowed ends of the Board. The Government was asked for an annual grant of 500*l.* in order to develop the area. As a result 150*l.* was voted for the first year.

In February last the New Zealand Institute, which consists of eight affiliated societies located in different centres of the Dominion, held a science congress at Christchurch under the presidency of Dr. L. Cockayne. The arrangements seem to have been modelled on the lines of the British Association, with public lectures, papers and discussions, excursions and a garden-party, the congress being opened by his Excellency the Governor-General. Apparently the New Zealand scientific workers no longer find the Australasian Association for the Advancement of Science adequate for their requirements, but we hope that the interchange of ideas and hospitality between the scientific workers in Australia and those in New Zealand will not suffer any diminution as a result of this interesting new departure.

The study of cytology, and more especially of the mitotic phenomena that accompany the division of the nucleus, has made such rapid progress in recent years that the question of terminology has become a very troublesome one, and the student who is not a specialist in this department is apt to find some difficulty in following the voluminous literature of the subject. In a memoir on "The Somatic Mitosis of *Stegomyia fasciata*," published in the *Quarterly Journal of Microscopical Science* (vol. lxiii., part 3), Miss Lucy A. Carter, at the request of the editor, has given a glossary of the principal terms employed. Some of these terms are, no doubt, already sufficiently familiar to ordinary students, but the idea is one which should be welcomed by many. The derivation of "synizesis"—"syn," with; "hizo," place—is not very satisfactory, for the word clearly means "assembling together" or "placing together."

A sub-committee of the Food (War) Committee of the Royal Society has recently issued a report on the composition of potatoes grown in the United Kingdom. The report is based on the results of deter-

minations of nitrogen and dry matter in 227 samples of ten varieties collected from sixty-five growers in eighteen English, seven Welsh, six Scottish, and twenty-three Irish counties. In addition to these, twenty "miscellaneous" samples were received and analysed. The report gives much valuable information as to the average composition of the potatoes grown in the United Kingdom, and discusses the variations in composition due to such causes as climate, soil, manuring, and size of tuber. The composition of different varieties and of different groups of varieties is also compared. Further work on many of these points is in progress. Perhaps the most important point raised by the issue of this report is the need for accurate information as to the composition of almost all home-grown foods. When the Royal Society Food (War) Committee was engaged in making its survey of the food supplies of the nation (Cd. 8421), one of the chief difficulties was the dearth of accurate systematic analyses of all kinds of home-grown foods, and the committee was forced to rely for the most part on American figures, which may not accurately express the composition of British-grown products. The report in question removes this difficulty for British-grown potatoes. It is to be hoped that reports on similar lines may follow dealing with other home-grown foods, but, unfortunately, work of this kind does not appear to be anybody's business. It is high time some organisation was set up to maintain on a permanent basis the survey of the food resources of the nation initiated by the Food (War) Committee of the Royal Society.

IN the March issue of *Terrestrial Magnetism and Atmospheric Electricity* Dr. L. A. Bauer and Messrs. H. W. Fisk and S. J. Mauchly complete their examination of the magnetic observations taken during the solar eclipse of June 8, 1918, and come to conclusions which may be summarised as follows:—Appreciable effects were observed during the eclipse at all stations within the zone of visibility, and warrant the statement that a solar eclipse causes a variation of the earth's magnetic field. The magnitude of the variation is from a tenth to a fifth of the solar diurnal variation of the element on a normal day. Its direction is, in general, opposite to that of the daylight portion of the solar diurnal change. The effects are seriously modified by the altitude of the observing station.

PARTICULARS of a large oil-fuel reservoir at Rosyth are given in the *Engineer* for April 4. The reservoir is in two sections, having a combined capacity of 60,000,000 gallons, and is constructed of concrete on a rock foundation. The retaining walls have an average height of 35 ft., and are reinforced with steel rods; each wall is in sections ranging from 54 ft. to 58 ft. in length, with expansion joints between. The concrete floor has a minimum thickness of 2 ft. 9 in., and the reservoir is covered with the roofing system known as the Belfast lattice-timber truss, with spans of 50 ft. Every precaution to secure oil-tightness was observed in the construction, with satisfactory results in the finished structure. The complete work occupies 11¼ acres, and the roof area is 7½ acres.

THE *Times* Engineering Supplement for April contains an article by Sir George Greenhill on geometrical and mechanical fit. The principles of geometrical fit were enunciated fifty years ago in the first edition of Thomson and Tait's "Natural Philosophy," but the message therein does not appear to have reached the mechanical engineer yet. The method of producing a geometrical rifle-rest described in Thomson and Tait appears to be too simple and subtle for the official mind to grasp, so the old-fashioned sealed pattern manifold point-rest is still at work, destitute of scientific theory, working against an excessive number of spring supports, and the rifle never returning exactly to the same position. It will be conceded by most people who have had business relations with instrument-makers that the principles of geometrical fits are still not generally understood. This is due, in part at any rate, to the conservative class of workmen employed. Sir George mentions the Cambridge Scientific Instrument Co. as using the geometrical fit principle, and might have added also the name of the firm of Barr and Stroud. There is no finer example of what can be done by geometrical appliances than the range-finder made by this firm.

AN illustrated account of a pulverised-fuel locomotive appears in the *Engineer* for April 25. The appliance has been invented by Mr. J. G. Robinson, chief mechanical engineer of the Great Central Railway, and, owing to the success already obtained, one of the large 2–8–0 engines is under construction with this apparatus. Up to the present the fuel employed consists of the settlings from the exhaust of the fans over the screening apparatus of the collieries, and has not received any treatment with the view of increasing its fineness, which is such that 80 per cent. will pass through a screen of 200 meshes per lineal inch; the ash content is about 10 per cent. Before being placed in the tender the fuel is dried by being stored for a few days over the flues of a battery of boilers. Considerable alterations have to be made in the internal arrangements of the fire-box in order to adapt it for burning pulverised fuel. The fuel is contained in a hopper in the tender, and fed to the furnace by conveyer screws driven by a small engine. On leaving the conveyers the fuel is met by a blast of air supplied by a fan driven by a de Laval steam turbine, and is led through pipes to the furnace. It would appear that this system of firing locomotives is at last attaining to a practical solution in this country as in America.

THE second report issued by the Conjoint Board of Scientific Societies states that the number of constituent societies is now fifty-four, and a list of these bodies, together with the names of their representative, is presented. A summary is given of the work of the various committees dealing respectively with (1) the Catalogue of Scientific Literature, (2) the application of science to agriculture, (3) national instruction in technical optics, (4) education, (5) the prevention of overlapping among scientific societies, (6) the metric system, (7) anthropological survey, (8) iron-ore, (9) water-power in the British Empire, (10) timber for aeroplane construction, (11) glue and other adhesives, (12) joint buildings for technical societies, (13) the foundation of a geophysical institute, (14) oxides and silicates, and (15) patent laws. The report issued by Committee No. 1 is at present confidential. No. 2 is considering the design, construction, and testing of electrical tractors and other agricultural machines. The committee dealing with education directs attention in a report on Civil Service examinations to the undesirable tendency to encourage mathematical studies to the detriment of other scientific subjects. In dealing with the scientific needs of the Civil Service the preponderance of appointments carrying literary rather than scientific qualifications demands attention, and as appointments are at present made largely by nominations, suitable men with scientific knowledge should be selected for appropriate administrative posts. The report issued on water-power in the British Empire has already been mentioned in these columns, and useful work has also been done in regard to the supply of timber for aeroplanes, glue, paper, etc. The foundation of a

geophysical institute, which is to deal with geodesy, tidal phenomena, seismology, and allied matters, has been approved, and a small committee is now formulating a definite scheme.

We notice the following among forthcoming books of science:—"Air Navigation Notes and Examples," Instructor-Capt. S. F. Card; "Tacheometer Tables," Prof. H. Louis and G. W. Caunt; "The Principles of Electrical Engineering and their Application," Prof. G. Kapp, vol. ii., Application (*Edward Arnold*); "The Pituitary," Blair Bell; "The Heart: Past and Present," Dr. E. Lea; "Injuries to the Head and Neck," Dr. H. Lawson Whale (*Baillière, Tindall, and Cox*); "The North Riding of Yorkshire," Capt. W. J. Weston; "Dumbartonshire," Dr. F. Mort, each in the Cambridge County Geographies Series (*Cambridge University Press*); "Economic Farm Buildings," E. P. Lawrence; "The Universal Wages Calculator," C. E. Lewton (*The Library Press, Ltd.*); "Kræpelin's Psychiatry," vol. iii., Dementia Præcox, translated by Dr. R. Mary Barclay, edited by Dr. G. M. Robertson; "A Handbook of Surgery (Civil)." C. R. Whittaker (*Edinburgh: E. and S. Livingstone*); "The Principles of Child Physiology, Pure and Applied," Dr. W. M. Feldman (*Longmans and Co.*).

OUR ASTRONOMICAL COLUMN.

Determination of Proper Motions.—In Circular No. 43 of the Union Observatory, Johannesburg, Mr. Innes publishes the result of an examination with the blink microscope of pairs of plates of eighty astrographic fields lent to him for the purpose by the Astronomer Royal, the plates of each pair being separated by an interval of nearly twenty years. The fields cover the zone of the sky from declination 65° to 67° N. through the whole twenty-four hours of right ascension, and out of the whole number of stars examined, estimated at 20,000, Mr. Innes has found nearly four hundred which have a measurable P.M., the large majority of which were previously unknown. The largest motions are 290″, 179″, and 167″ centennial on a Great circle. There are five between 50″ and 100″, sixty-seven between 20″ and 50″, and more than 300 less than 20″ centennial. Two hundred and fifty of the stars are in the Bonn Durchmüsterung, and are, therefore, of all magnitudes down to 9·5 or 10 visual, whilst the remainder are of photographic magnitude 10 to 12, with a few fainter. It will be realised that the motion of a star thus determined is relative to the stars in a limited area surrounding it, and not to the heavens as a whole. The systematic character of the figures in the table gives assurance that Mr. Innes's work forms a useful contribution to stellar statistics.

The Blink Microscope.—The fundamental principle of this instrument is somewhat obscured by its name. Having two similar photographs of the same field of stars taken at some interval of years apart, the obvious method of determining motion would be to superpose these plates with identical images fitting one on the other so far as possible, and then to search for those images which do not fit. As actual superposition is difficult, or impossible, for practical reasons, a method only slightly less simple is to adjust the plates side by side and measure the distances between identical images with a measuring bar. This is the principle of more than one type of instrument now being used to determine proper motion. In the blink microscope the images of the same star on the two plates are seen alternately by rapidly closing and opening shutters. Hence the name. Two images which fit fall on the same spot of the retina, but those of a star which has motion do not, and give the sensation of a jump. The method of detection is therefore simple, but it is clear that the measurement must be made with discretion lest errors occur because of imperfect adjustment or lack of exact similarity of the plates.

Calculation of Occultations of Stars by the Moon.—Mr. Arthur Snow publishes some tables for this purpose in *Popular Astronomy* for February, which should be of great use to those who do not live near one of the stations (Greenwich, Washington, etc.) for which special lists are available. He directs attention to the fact that the region of visibility of an occultation is a belt about half as wide as that for a total solar eclipse, crossing the parallels of latitude at a considerable angle, so that by no means all the places that lie between the published latitude limits enjoy a sight of the phenomenon. He gives full directions, which enable the limits of visibility to be laid down on a map.

X-RAYS AND BRITISH INDUSTRY.

The war has furthered the progress and development of many industries, but probably no department of science has received greater impetus than that of radiology, using the word in the general sense which it ought usefully to convey, and not in that restricted sense which the medical world has attached to it. The science and art of X-rays have developed enormously during the war, and nothing but good can result from the fact that the general medical practitioner has had his eyes opened to the vista which the X-rays have revealed. He now realises, as never before, that radiology is a new instrument of attack for him—a veritable handmaiden, whether he be physician or surgeon. The new diploma of radiology which Cambridge and other universities are about to establish is tacit recognition of the importance of X-rays in a medical curriculum. We welcome the suggestion that a chair of radiology should be established at one of the universities in memory of the late Sir James Mackenzie Davidson.

But it is not our purpose at the moment to dwell on the medical aspect of the rays. We are more concerned with a development to which the Germans, Americans, and ourselves have given considerable attention during the past year or more. We refer to the examination of materials and built-up structures by X-rays—a subject to which a joint meeting of the Röntgen and Faraday Societies in the meeting-room of the Royal Society devoted its attention on April 29.

It is a very far cry from the days of Röntgen's famous discovery some twenty-two years ago to the present time. The technique has advanced amazingly, but it can scarcely be said that apparatus and equipment have made corresponding strides, although it is, of course, not denied that considerable progress has been made. We refer to this point later, but the question is tied up with the attention the subject has received at the hands of the physicist and electrical engineer.

The meeting to which we have referred served admirably to set out the development and present limitations of the industrial uses of X-rays, and those of our readers who are interested may be referred for details of the meeting to the journals of the two societies concerned.

The great advantage of radiography is, of course, the fact that we can spy out the interior of an opaque body without injuring it in any way. Chief among the materials which have been examined by the X-rays is steel, both carbon and alloy. Naturally, the question of blow-holes and flaws in castings and

forgings and ingots has received attention, and, provided that the thickness is not too great, the method works well. X-ray scrutiny has also suggested improvements in methods of casting and welding, as well as modifications in the composition of alloys, with a view to the surer production of sound castings.

Heavy alloy steels, such as tungsten steels, are, by reason of their greater opacity to X-rays, readily distinguishable from carbon steels. The method has also been applied, with, however, little or no success, to the detection of hair-cracks in steel castings. These cracks (which are of the order of 1/1000 in. across) have caused great trouble during the war in connection with the crank-shafts of aeroplane engines. The only way of attacking the problem would be to send the rays along the direction of the crack, but the difficulty is that these cracks refuse to confine themselves to one plane!

So far as the thickness of steel is concerned, several workers have taken radiographs through about 2 in. of steel, and this figure may be taken as the practical limit at the moment. Not that greater thicknesses have not been penetrated, but the exposure becomes intolerably long. In the case of aluminium and its alloys, thicknesses of 4 in. or 5 in. have been radiographed with ease. Incidentally, the method is very sensitive to minute differences in thickness—for example, the tool-marks used to face specimens are often clearly shown in radiographs of metals.

The voltages normally employed have ranged between 100,000 and 150,000 volts, and the currents through the tube from 4 to 15 milliamperes. The question of protecting the operator in this work needs particular attention.

In steel examination there is no possibility of using the fluorescent screen. Practically all workers have used photographic methods, and, furthermore, have been driven to adopt methods of reinforcing the image on the plate by the use of intensifying screens, metal-backing, or other devices. Pilon and Pearce have obtained good results with photographic films sensitised on both sides and sandwiched between two intensifying screens. They found it possible to determine a thickness of 1/10 mm. through 45 mm. of steel. All workers have found it important to cut out all extraneous radiation.

The X-ray method of examination is naturally very useful in examining explosive objects—for example, the details of the internal construction of torpedoes, shells, fuses, bombs, grenades, and cartridges. Aircraft construction demands both workmanship and material of the highest class, and a new grade of timber is now specified for this work of a quality such as has never been demanded previously. Knox and Kaye have turned the X-rays to account in inspecting aeroplane timber parts and plywood for faults which cannot be seen by ordinary visual examination. Concealed knots or gum-pockets, bad gluing, or poor workmanship are readily revealed. Only soft rays are necessary, and the great transparency of wood permits fluorescent-screen examination—a necessity for routine inspection—and allows any thickness likely to occur in practice to be radiographed readily.

The motor manufacturer has radiographed carburettors and magnetos while in operation, and so has been enabled to detect elusive faults. The Hadfield Research Laboratory, which has done much work on radio-steel examination, has extended the method to the scrutiny of carbon electrodes for electric steel furnaces. The Post Office has used the rays for testing the amount of mineral matter in gutta-percha. Woolwich Arsenal has also used the method. Radiography would doubtless prove to be a convenient means of detecting hidden corrosion in metals—for example, in gas cylinders, in ferro-concrete, or in the armouring of cables. Mention should be made of the coming importance of stereoscopic radiography.

There is one other and entirely different way in which X-rays may supplement the radiographic method of examining material. Prof. W. H. Bragg, to whom the subject owes so much, has shown that the X-rays enable us to examine in detail the nature and extent of the crystallisation of a body. Now it appears to be the case that there is little in Nature which is not crystalline to a greater or less degree, and, further, it is certain that crystalline structure is of first importance in determining the quality of certain substances such as steel. A large field of research is here indicated.

We do not anticipate any startling developments in the use of X-rays for the examination of steel until the present apparatus for generating X-rays has been vastly improved. We are led to inquire what part this country has played in the past in the development of either the high-potential generator or the X-ray tube. The answer is not very gratifying. The British generator is almost always an induction coil of which the present-day model differs but little in essentials from its predecessor of Spottiswoode's day, except that it is capable of a "fatter" spark and greater output generally. It breaks down less frequently owing to closer attention to the insulation of both primary and secondary coils. But what of design? How many British coil-makers employ a designer who can honestly say that he is not working mostly empirically, by trial and error, by "hit and miss," or whatever you like to call it? The fact is, the man who could do things any other way—by reasoned calculation and experiment—has so far not had it made worth his while to work at the subject. Moreover, how and where are men to be trained in the groundwork of the subject? In how many university physical or electrotechnical laboratories does the matter receive even the smallest attention?

What would prove to be the result of reasoned investigatory work on the induction coil? Compared with other types of high-tension transformer the present-day induction coil is not efficient, and the chances are that it never will be. At any rate, our American cousins have come to that conclusion, and are concentrating on closed-circuit, interrupterless transformers which can operate with any commercial A.C. supply, and are generally used in conjunction with some type of hot-cathode "rectifier" to suppress the "inverse" phase of potential. The British answer has mostly been to point out that the sinusoidal potential wave is not so efficient an X-ray producer as the peaked wave of an induction coil. Of the degree of practical importance of this difference we have no experimental knowledge. It is probably on a par with the oft-repeated, but untrue, statement that a Coolidge tube is not so good as an ordinary gas tube for securing first-class radiographs.

This leads us to the question of the X-ray tube. Its present efficiency is of the order of 1/1000. We are led to inquire in what outstanding points has the British tube made progress since Sir Herbert Jackson's introduction of the concave cathode in 1897—itself identical with one used by the late Sir William Crookes some twenty years previously. Again, has the British tube ever been superior to either the German or American? We know the answer most radiographers would give us. Before the war we could not even make the glass for the bulb. But that is another story. From the point of view of the Old Country, it is a regrettable fact that it should have been left to America to develop (in the shape of the Coolidge tube) pioneer research work done by

Englishmen. The latest model of the Coolidge tube acts efficiently as its own rectifier, and the high-tension outfit is correspondingly simplified.

In simple justice one must add that the scientific energies of this country have been far more distracted and dislocated by the war than have those of America. But the Department of Scientific and Industrial Research ought to have no hesitation in adding to the list of investigations it has tackled during and since the war.

To return to the question of future developments of the X-ray scrutiny of metals. The question of the light alloys is relatively simple, but for the heavier metals we need photographic plates and fluorescent screens of much higher efficiency. In addition, we need a method of generating X-rays in far greater abundance and of far greater hardness (*i.e.* shorter wave-length) than we have at present. In this connection every investigator and user ought to develop the habit of precise measurement of both current through the tube and, more important, the potential difference across the terminals. The voltage is commonly left to be inferred as well as may be from the alternative spark-gap between electrodes the size and shape of which are rarely mentioned. Or, more frequently, the hardness of the rays is given in some arbitrary unit difficult to define or reproduce. But radiology generally rejoices in a wealth of indefinite units and measuring instruments, mostly introduced by workers who had enthusiasm but little physics. The subject of practical radiology has, unfortunately, been severely ignored by the physicist and the electrical engineer. Their assistance in this matter is earnestly needed both by the medical man and by the workers in this new field of the application of X-rays to the examination of materials. The Röntgen Society has on its roll of members most of the younger X-ray physicists in the country, and we suggest that it should take early steps to co-ordinate the unrivalled experience and equipment of its physical and medical members for the ultimate benefit of British industry.

G. W. C. KAYE.

RADIO-TELEGRAPHIC INVESTIGATIONS IN CONNECTION WITH THE SOLAR ECLIPSE OF MAY 29, 1919.

IT will be remembered that in a letter to NATURE of February 13 last Sir Oliver Lodge, chairman of the British Association Committee for Radiotelegraphic Investigation, explained that his committee did not contemplate taking a very active part in organising wireless observations during the forthcoming solar eclipse, and hoped that parties travelling to the eclipse zone for the observation of astronomical, meteorological, and magnetic phenomena might be able to make wireless telegraph observations also. Later it was found that the various parties charged with the other observations would be too fully occupied to give any attention at all to wireless telegraphy, and therefore the committee has arranged for the carrying out of the experiments to be described below.

The umbra intersects the earth's surface in an approximate circle of diameter of about 234 km. (126 sea-miles), and it moves at the slowest at a speed of about 0·57 km. (0·31 sea-mile) per second. Between 11.30 and 12 (Greenwich mean time) it travels across Bolivia and Brazil, and crosses the Atlantic close to the equator between 12 and 14.20. It then crosses the African continent from the French Congo to Mozambique. During the eclipse various wireless telegraph stations will emit signals consisting of letters of the alphabet changed according to a definite plan at the end of each minute; the programme of letters is so arranged that no two come together in the same order more than once. They will be accurately timed at selected receiving stations. By this arrangement the transmitting stations are relieved of the responsibility of timing the signals accurately, and the receiving operators have nothing to do but to write down each letter as they receive it and the number denoting its strength on the scale (0 to 9) familiar to all wireless telegraphists. On the day before the eclipse the stations will send practice signals for a short time near noon (G.M.T.).

The British Admiralty stations at Ascension and the Azores will send continuously during the transit of the umbra across the Atlantic Ocean. Observing stations north of the equator will, for the most part, be asked to listen to Ascension for at least an hour round about the time when the umbra passes between themselves and Ascension. Similarly, observers south of the equator will be asked for the most part to listen to the Azores. Certain selected stations north of the equator will be asked to listen to the Azores so as to afford check observations upon the variations that may be observed in signals passing across the central line of the eclipse, and similarly selected stations south of the central line will be asked to listen to Ascension. The great American station at Annapolis may also transmit a programme during a portion of the period of the eclipse, and it is hoped that arrangements may be made for special experiments between a few pairs of stations, such as Darien and the Falkland Islands, and an Egyptian station and a South African station.

The main portion of the experiment hinges upon Ascension. The umbral cone passes from west to east, and may be expected to affect in succession the strength in which signals are received at such stations as Demerara, Jamaica, the stations on the coast of the United States and Canada, and stations in Ireland, England, France, Italy, the Mediterranean, and Egypt.

It is by the kindness of the American Government and of our own Admiralty that the stations at Darien and Annapolis, and at Ascension and in the Azores, are being used for the sending of the experimental waves. The Admiralty has, besides, provided many of the receiving stations both on land and sea, and other receiving stations are being put to work by the American, French, and Italian Governments, by our own Army and Air Force and also by the Marconi Co. in several parts of the globe.

The observers' results will be collated with the view of finding if the passage of the shadow cone between a sending and a receiving station causes any regular change in the strength of signals. According to some writers, the propagation of waves over long distances is greatly affected by the ionisation of the upper atmosphere. During a solar eclipse the cone of densest shadow removes all sunlight from the atmosphere within it, which may stop the ionising actions of sunlight and allow the recombination of separated ions to take place. This process starts in the penumbra, but it is accomplished fully, or to its fullest extent, only in the umbra. Thus at any particular fixed place in the air the penumbra, it is thought, first starts a gentle recombination of ions, and as the eclipse at that place progresses and darkness increases, recombination of ions takes place more and more quickly until the time of complete totality. Afterwards the onward passage of the umbral cone allows sunlight to begin again its ionising action. Something of this kind is, at any rate, supposed to be taking place at sunset and sunrise every day, and to be the main cause of the enormous variations experienced in signal strengths at those times.

It is sometimes supposed that the electric waves carrying signals take a curved trajectory in the atmo-

sphere from one point to another. In this case signals passing between two stations at a short distance apart will traverse lower levels of the atmosphere than those passing between stations separated by a great distance. The eclipse probably affects the ionisation of the upper and lower layers of the atmosphere differently, and therefore we may expect to get different effects on long- and short-range signals. Moreover, it has been shown to be probable that long waves are more affected than short waves by changes of the ionisation of the air through which they travel. The elucidation of this point is one of the aims of the observations.

Anyone desirous of obtaining further information should communicate with Dr. W. Eccles, honorary secretary of the committee, City and Guilds Technical College, Leonard Street, London, E.C.2.

THE BUREAU OF STANDARDS AND THE WAR.

THE most obviously noteworthy feature of Dr. Stratton's report on the work of the U.S. Bureau of Standards for the year ended June 30, 1918, is the very extensive field of investigation covered. A large part of the work was necessarily related to the war; the expenditure increased from about 140,000*l*. in 1916–17 to more than 600,000*l*. in 1917–18, of which 220,000*l*. appears under the head of "National Security and Defence," and is made up mainly of sums expended on new buildings and laboratories, additional to the growth of ordinary expenditure due to war conditions. The value of the tests made, chiefly for the Government, is given as 20,000*l*.; and the number of persons employed as 1405, of whom 839 were engaged in research and investigations specially authorised by Congress. The figures are useful as an indication of the expansion which has taken place.

The report opens with a brief account of the functions and organisation of the Bureau, which, if space permitted, it would be interesting to review in detail. It affords a valuable study in these days of reconstruction. The functions of the Bureau are stated to be the "development, construction, custody, and maintenance of reference and working standards, and their intercomparison, improvement, and application in science, engineering, industry, and commerce"; while the standards are classified under the five headings: standards of measurement, standard constants, standards of quality (of materials), standards of performance (of machines and devices), and standards of practice. The relations of the work of the Bureau to the public and to the Government service are examined in a manner which brings out prominently the important *rôle* the institution plays in connection with the national life and industry.

The remainder of the report, some 180 pages, deals, for the most part in short paragraphs, with the innumerable items of research and test work which have received attention in the various scientific and technical divisions. These departmental reports contain little more, in many instances, than a concise statement of matters investigated; in turning over the pages, among the many points of interest, a few only can be selected for comment. A new equipment has been provided for measuring expansion up to temperatures above 900° C. The examination of mine-scales, used for weighing coal mined, led to the detection and removal of serious errors due to faulty weights, improper installation, and neglect in maintenance. The testing of gauges for the Ordnance Department was undertaken by the Bureau, as in this country by the National Physical Laboratory, though on a much smaller scale than here. Branches were established at New York and elsewhere, and the manufacture of gauges was commenced.

In the electrical department ignition in petrol engines was studied, and improved porcelains for sparking plugs, developed by the ceramic laboratory, were put into production. A special method was devised for determining the velocity of projectiles. The method of "magnetic analysis" as a criterion of the quality of steel has been further investigated and applied in practice. The photometric work included tests of field searchlights and the investigation of gas-filled standards of spherical candle-power. For wireless work a new building was nearly completed. Sound-ranging was among the problems taken up by one of the electrical sections. An account is given of the relation of the Bureau to municipalities and public service commissions in securing safety and standardisation in connection with electricity and gas supply; some particulars are included of the national electrical safety code. The subject of electrolysis of underground pipes, cables, and other metal structures from stray earth-currents is prominently mentioned, and may need to be taken up actively in this country.

In the work of the heat department may be noted the determination of refrigeration constants, including the thermal constants of ammonia. The fire-resisting properties of structural materials, reinforced concrete, etc., under load were examined. An apparatus was completed for strength tests of metals at temperatures up to 800° C. The work on aeroplane power plant included the construction of an altitude laboratory for engine tests under reduced pressure and at various temperatures, and a number of tests on engines have been carried out. The construction of radiators has also been the subject of research.

The researches in the optics department have included much spectroscopic work, dealing especially with the red and infra-red regions of the spectrum, landscape photography with red-sensitive plates, colour-filters, etc. The great value of red-sensitive plates in penetrating haze has been demonstrated, and another important characteristic of these plates is said to be their power to detect *camouflage* designed to defeat the eye. Quantitative, as well as qualitative, methods of spectroscopic analysis have been employed. Polarimetry has received much attention, especially in connection with the estimation of sugar, and interesting results have been obtained with regard to the natural rotation of quartz at high temperatures; an abrupt change was found to occur at about 574° C. In connection with the polarimetric work intense monochromatic light sources were necessary, and, after experiment with cadmium amalgam lamps, a lamp using a new alloy has been produced. A novel method for the production of artificial daylight makes use of the rotatory dispersion of quartz.

A considerable amount of attention in the optics and chemistry departments has been given to the production of optical glass. The Bureau is said to be shipping glass in quantity for the manufacture of optical instruments. Some seven or eight varieties of the most used glasses are being produced, including a dense barium crown. For this work a new glass laboratory was erected in 1917. Much investigation has necessarily been devoted in this connection to the production of pots for melting.

The work of the chemistry section has included the study of electroplating and electrotyping; the improvement of the electrolytic method of estimation of carbon in steel so that an accurate determination can now be made in 4½ minutes; the testing of balloon fabrics and the investigation of balloon gases, together with chemical work on oils, rubber, paper, textiles, ink, glue, cement, bitumen, and other materials. It

is noted that in the testing of balloon fabrics no satisfactory equivalent for exposure to weather has been found, confirming experience in this country. There was a greatly increased demand for standard analysed samples as furnished by the Bureau.

The engineering section of the Bureau is responsible for the control of a large amount of routine testing work of various kinds, some of which is carried out in branch laboratories. For work in aerodynamics a new building and wind-tunnel have been provided; the latter is octagonal in section, the distance between opposite faces being $4\frac{1}{2}$ ft., and a wind-speed of ninety miles per hour is obtained with an expenditure of 85 h.p. Autographic instruments for measurements on aeroplanes in flight have been designed. Much work has also been done on materials for aircraft construction and the strength of aeroplane parts. The inspection and testing of cement and concrete for the Government and the public are on a large scale, and have included investigations relating to concrete ships. Stress reversal tests on reinforced concrete beams have been carried out. Lubricating oils have been investigated. The textile division has given attention to aeroplane and balloon fabrics; a cotton fabric for wing-covering was produced with the aid of the manufacturers which was considered superior to linen, and has been widely used.

In the metallurgy division considerable developments have taken place, and a brief description is given of the new laboratories and equipment installed, which will be found of interest. As at the National Physical Laboratory, light alloys for the construction of aircraft and aircraft engines have received a great deal of attention, and evidence of co-operation appears in the adoption of a programme to supplement work done here. Stress is laid on the necessity for the systematic study of constitution to secure further progress. The properties of metals at high temperatures are being investigated. Ceramics is also a subject on which much research is in progress.

This brief survey will suffice to show that the report contains evidence of a vast amount of scientific and industrial research which will be of the greatest interest and importance to those who are working on parallel lines in this country. A special feature of the work of the Bureau is the attention given to methods of making available for ready reference throughout the country the results of the various investigations. Four separate series of publications are issued: (i) scientific papers, (2) technologic papers, (iii) circulars, and (iv) miscellaneous publications; these are widely distributed to institutions and libraries. The need in this country of more effective means for the rapid dissemination of technical information among those to whom it is of value has been very apparent during the war, and in the consideration which is now being given to this matter the methods adopted by the Bureau will be found to merit careful examination.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Dr. S. W. J. Smith, F.R.S., assistant professor at the Imperial College, South Kensington, and for many years secretary of the Physical Society of London, has been elected to the Poynting chair of physics in the University.

CAMBRIDGE.—Sir Ernest Rutherford, Cavendish professor of experimental physics, has been elected to a fellowship at Trinity College.

Dr. H. Hartridge, of King's College, has been appointed demonstrator of physiology until September 30, 1921.

Mr. Bennett Melvill Jones and Mr. James Wyvill Lesley have been elected to junior fellowships at Emmanuel College. Mr. Jones was placed in Class I. of the Mechanical Sciences Tripos, 1909, and has been awarded the Air Force Cross for his work with the Royal Air Force, of which he has been a temporary lieutenant-colonel. Mr. Lesley was placed in Class I., Part I., of the Natural Sciences Tripos in 1910, and obtained the agricultural diploma. He was awarded a scholarship of the Board of Agriculture in 1911, and was a student of the John Innes Institution, 1912. He was temporary captain in the K.R.R.C., gained the Military Cross, and was a prisoner in Germany, 1917–18.

DR. BOON has been appointed to the chair of chemistry at Heriot-Watt College, Edinburgh.

MR. R. W. H. HAWKEN has been appointed to succeed Prof. A. J. Gibson as professor of engineering in the University of Queensland.

WE learn from the *Morning Post* that a donation of 10,000*l*. has been given to the Cape University by the National Bank of South Africa.

MR. W. J. JOHN, formerly a wireless telegraphy engineer under the Admiralty, has been appointed lecturer in electrical engineering at the East London College.

THE *Times* announces that Dr. James Younger and his wife have given 30,000*l*. to provide the University of St. Andrews with a memorial hall. The main hall, to be used for University purposes, is to have an organ and to accommodate a thousand. There will also be a smaller hall.

AN ingenious astronomical model for schools and colleges, devised by Dr. W. Wilson, was described in NATURE of May 2, 1918, p. 173. Demonstrations on the uses and working of this model are being given by the inventor in the show-room of Messrs. George Philip and Son, Ltd., 32 Fleet Street, and the concluding one will be on Saturday, May 10, at 11.30 a.m.

MRS. ELLEN MORGAN has bequeathed 1000*l*. to the University of Liverpool for a John H. Morgan scholarship to be awarded to students of the University who have passed the Matriculation Examination and intend to proceed to a degree of faculty of engineering, and who or whose parents are too poor to defray the ordinary expenses of pursuing an academic career at the University.

BY the will of Dr. J. Percival, late Bishop of Hereford, the following bequests will be made:—1000*l*. to Appleby Grammar School; 2000*l*. to Clifton College; 1000*l*. each to Queen's College, Oxford, and Trinity College, Oxford, all for helping scholars of distinguished ability who are in need of assistance to meet educational expenses; and 1000*l*. to the Bishop of Hereford for the education of one or two boys or girls.

THE President of the Board of Education has appointed a Departmental Committee to inquire into the position occupied by English (language and literature) in the educational system of England, and to advise how its study may best be promoted in schools of all types, including continuation schools, and in universities and other institutions of higher education, regard being had to (1) the requirements of a liberal education; (2) the needs of business, the professions, and the public services; and (3) the relation of English to other studies. The chairman of the Committee is Sir Henry Newbolt, and the secretary Mr. J. E. Hales, to whom all communications should be addressed at the Board of Education, Whitehall, London, S.W.1.

After an interval of four years, due to the circumstances of war, the eighth annual general meeting of the Old Students Association of the Royal College of Science, London, will be held on Saturday, May 24, at 3.30 p.m., at the Imperial College Union, Prince Consort Road, South Kensington. The meeting will discuss the important questions raised by the petition to the governing body of the Imperial College, signed by past and present students of the Royal College of Science, requesting it to take immediate steps to raise the status of the college to that of a university of technology, empowered to confer its own degrees in science and technology. At the conclusion of the regular business an address will be given by the retiring president, Prof. H. E. Armstrong. The eighth annual dinner of Old Students will be held at the Café Monico after the general meeting. Tickets may be obtained from the secretary, Mr. T. Ll. Humberstone, 21 Gower Street, W.C.1.

A conference attended by representatives of the professorial and non-professorial teaching staffs of the university institutions of England, Wales, and Ireland, with Mr. R. D. Laurie, of the University College of Wales, Aberystwyth, as chairman, met at the University of Sheffield on April 11 to discuss the position with regard to superannuation, in view of the recent Act, which confers non-contributory pension benefits upon all teachers in State-aided institutions except university teachers. Since 1913 there has been a pension scheme for universities of a contributory character, known as the Federated Superannuation Scheme, under which the State pays one-half of the total contribution and the other half is paid by the beneficiary. This scheme, which in its present form compares very unfavourably with the non-contributory scheme under the Teachers (Superannuation) Act, is mainly applicable, however, to professorial staffs, as the majority of lecturers are in receipt of salaries so low that they cannot afford to make the necessary contribution. After discussion at the recent meeting, a motion, "That this conference wishes to urge strongly that the Teachers (Superannuation) Act, 1918, be extended so as to include the staffs of universities and university colleges," was carried with only one dissentient. A further resolution, carried unanimously, was:—"That this conference urges that before any modification of the Federated Superannuation Scheme for university teachers be adopted, an opportunity be given to the various sections of the staffs of the universities to place their views directly before the President of the Board of Education and the Treasury, and that this resolution be communicated immediately to the President of the Board of Education." It was also decided to communicate with all the associations of teachers in schools which come under the present Act to advise them of the action being taken by the conference.

A conference to direct attention to the position of science in the educational system of the country was held at the Central Hall, Westminster, on April 30, under the auspices of the League for the Promotion of Science in Education. The chair was taken by Lord Leverhulme, who said that our system of education should take into the fullest possible consideration the means that science had placed at our disposal in the daily life and industries of the nation. Three resolutions were submitted to the conference and carried unanimously. The first of these emphasised the importance of having an adequate representation of scientific men in all Government Departments, and in proposing it Mr. Sanderson, the headmaster of Oundle School, deplored the lack of scientific outlook by Government officials, and criticised the new regulations for the Civil Service examinations. Sir Philip Magnus, M.P., in seconding, emphasised the fact that the league did not in any way desire to favour scientific teaching at the expense of so-called humanistic studies. They wished, however, to encourage the adoption of the scientific method in all branches of learning. Mr. Charles Bright supported the resolution, and suggested that men of scientific and business experience might well be introduced into the *personnel* of Government Departments. Mr. Arthur Lynch, in proposing the second resolution calling for a pronouncement by the Government as to its attitude towards the recommendations of Sir J. J. Thomson's report, criticised the lack of scientific knowledge of Members of Parliament in matters of general education. Lord Headley seconded this resolution, and attributed the indifference to matters of this nature to the lack of scientific education, which alone could produce action and organising ability. The third resolution was proposed in a forceful speech by Dr. H. B. Gray, formerly headmaster of Bradfield College, who expressed the view that the present public school and university system failed to produce that activity of mind and breadth of knowledge which were necessary for dealing satisfactorily with modern problems. Mr. Edward Berkeley, a member of the council of the National Union of Manufacturers, seconded this resolution.

SOCIETIES AND ACADEMIES.

London.

Royal Anthropological Institute, April 8.—Sir Everard im Thurn, president, in the chair.—Lieut. E. W. Pearson **Chinnery**: Reactions of certain New Guinea primitive people to Government control. It is the desire of Australia to put down cannibalism and general savagery and introduce civilisation among people of the Stone age in Papua without injury to them. Cannibalism and savagery are essential parts of the social and religious fabric of an uncivilised community. If they are to be suppressed without injury to the people, alternative practices of equal potency must be substituted to perpetuate material welfare and develop cultural institutions in accordance with the laws of the Government. Since the wild tribes of Papua received their first alien stimuli through the magistrates of their districts, progress depends on the ability of these officers to establish a proper relationship of mutual understanding and confidence between Government and subjects. When this is attained the officers, by intensive study of the culture of their people, can acquire a knowledge of the modes of thought that produce customs antagonistic to civilised standards, and safely guide the people through the stages of transition. If a system of training district magistrates in anthropological methods is added to existing methods of administration, Australia should, in the shortest possible time, achieve the credit of having conducted the savage of the Stone age, without injury to him, to an attainment of the ideals of civilisation.

Paris.

Academy of Sciences, April 22.—M. Léon Guignard in the chair.—D. **Berthelot**: Notice on the work of Sir William Crookes.—G. **Bigourdan**: The work of Le Monnier at the meridian of Saint-Sulpice. The end of the observatory of the rue Saint-Honoré.—G. **Julia**: Some properties of integral or meromorphic functions.—A. **Guldberg**: The law of errors of Bravais.—G. **Guillaumin**: Certain particular solutions of the problem of sandy flow.—MM. **Jouguet** and **Crussard**: The velocity of deflagrations.—M. **Amans**: Equations of similitude in propulsive helices.—M. **Picon**: The

action of the monosodium derivative of acetylene on some halogen esters of secondary and tertiary alcohols. The reaction differs from that shown by halogen esters of primary alcohols, and the corresponding acetylene compounds are not formed. Halogen acid is eliminated and ethylene hydrocarbons are produced.—J. **Amar**: The curve of pulmonary ventilation. A study of the effects of physical fatigue on respiration.

April 28.—M. Léon Guignard in the chair.—H. **Parenty**: Presentation of a miniature model of a steam recorder. The apparatus, a photograph of which is given, is based on the measurement of pressure in front and behind a constriction in the pipe.—A. **Righi**: Michelson's experiment and its interpretation.—M. **Carleman**: The conformable representation of multiply connected domains.—L. E. J. **Brouwer**: The enumeration of finite groups of topological transformations of a tore.—A. **Denjoy**: The true value of definite integrals.—R. **Biquard**: A modification of the fluorometric method of measuring X-rays and its application to the measurement of the radiation from Coolidge bulbs. Measurements with fluorescent screens cannot give a value of the radiation in absolute measure, since the fraction of the incident energy absorbed by such screens may vary, according to the nature of the X-rays, between 53 and 20 per cent. of the whole, and matters are not improved by increasing the thickness of the screen, since the observed brightness is due to the superficial layers only. This difficulty is avoided by the use of a sufficient number of thin screens (0·2 mm.).—M. **de Broglie**: The spectroscopy of the X-rays. The L absorption spectrum of radium.—J. **Bourcart**: The presence of the Priabonian in the Salonica region.

BOOKS RECEIVED.

Botany of the Living Plant. By Prof. F. O. Bower. Pp. x+580. (London: Macmillan and Co., Ltd.) 25*s.* net.

Premiers Eléments d'une Théorie du Quadrilatère Complet. By A. Oppermann. Pp. 76+plate. (Paris: Gauthier-Villars et Cie.)

Technic of Surveying Instruments and Methods, including General and Detailed Instructions for Field and Office Work of Extended Students' Surveys. By Profs. W. L. Webb and J. C. L. Fish. Pp. xvi+319. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 9*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, MAY 8.

INSTITUTION OF ELECTRICAL ENGINEERS (Joint Meeting with the Iron and Steel Institute), at 2.30.—J. Bibby: Developments in Iron and Steel Electric Furnaces.—W. H. Booth: The Booth-Hall Electric Furnace.—H. A. Greaves: Application of Electrical Energy to the Melting of Metals.—R. G. Mercer: Electric Furnaces in the United Kingdom, 1918.—Axel Sahlin: A New Type of Electric Furnace.—Victor Stobie: Large Electric Steel Melting Furnaces.

ROYAL INSTITUTION, at 3.—Dr. H. S. Hele-Shaw: Clutches.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Annual General Meeting.—Hugh K. Picard: Presidential Address.—H. Standish Ball: The Work of the Miner on the Western Front, 1915–18.

OPTICAL SOCIETY, at 7.30.—Prof. F. J. Cheshire: Presidential Address—Polarised Light.—J. Rheinberg: Graticules.

FRIDAY, MAY 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A. W. Clayden: Note on the Blue Violet Absorption of Venus.—E. Doolittle: Note on Espin's List of New Double Stars.—A. N. Brown: Observations of U Persei in 1911–19.—A. Pannekoek: The Distance of the Milky Way.—*Probable Papers*: Rev. T. E. R. Phillips: Micrometrical Measures of Double Stars in 1918.—Rev. A. L. Cortie: The Spectrum of Nova Aquilæ, 1918, July 29.—W. M. Smart: Note on the Position Line of Navigation.

PHYSICAL SOCIETY, at 5.—A. E. Bawtree: Demonstration of a New Method of Producing Coloured Designs upon Glass.—F. J. Whipple: Absolute Scales of Pressure and Temperature.—Dr. A. O. Rankine: The Transmission of Speech by Light.

ROYAL INSTITUTION, at 5.30.—Sir George Macartney: Chinese Turkistan—Past and Present.

MALACOLOGICAL SOCIETY, at 6.—G. B. Sowerby: A New Species of Ampullaria in the Geneva Museum.—Dr. A. E. Boycott: Parthenogenesis in *Paludestrina jenkinsi*.—Tom Iredale: Notes on the Mollusca of Lord Howe Island.

SATURDAY, MAY 10.

ROYAL INSTITUTION, at 3.—Prof. H. S. Foxwell: Chapters in the Psychology of Industry.

MONDAY, MAY 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A. Trevor Battye: Crete: its Scenery and Natural Features.

TUESDAY, MAY 13.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: British Ethnology—The People of Ireland.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Sir Everard im Thurn: Dwellings and Costumes of Old Fiji, illustrated by Lantern Slides and Specimens.

ZOOLOGICAL SOCIETY, at 5.30.—Lt.-Col. S. Monckton Copeman: Experiments on Sex Determination.

WEDNESDAY, MAY 14.

ROYAL SOCIETY OF ARTS, at 4.30.—H. Kelway-Bamber: Railway Transport in the United Kingdom.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Major J. Erskine-Murray: Wireless in the Royal Air Force.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section), Medical Society of London, 11 Chandos Street, W.1, at 8.30.—Dr. W. H. R. Rivers: Inaugural Address—The Objects and Work of the Section.

THURSDAY, MAY 15.

ROYAL INSTITUTION, at 3.—Prof. F. Keeble: Intensive Cultivation.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Prof. W. H. Young: (1) The Area of Surfaces; (2) Change of the Independent Variables in a Multiple Integral.—Prof. W. A. Bone and R. J. Sarjant: Researches on the Chemistry of Coal. I. The Action of Pyridine upon the Coal Substance.—Prof. E. F. Burton: A New Method of Weighing Colloidal Particles.—W. E. Curtis: The Value of the Rydberg Constant for Spectral Series.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. H. E. Armstrong: Soil Deficiencies in India, with Special Reference to Indigo.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—E. A. Laidlaw and W. H. Grinsted: The Telephone Service of Large Cities, with Special Reference to London.

CHEMICAL SOCIETY, at 8.—B. Blount and J. H. Sequeira: "Blue John and other Forms of Fluorides.—G. M. Bennett: The Nitration of Diphenylethylenediamine.—D. L. Hammick: The Destruction of Picric Acid in Nitrating Acid.—J. C. Irvine and J. S. Dick: The Constitution of Maltose. A New Example of Degradation in the Sugar Group.—R. J. Manning and M. Nierenstein: The Tannin of the Canadian Hemlock (*Tsuga Canadensis*, Carr).

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 5.30.—Dr. S. F. Harmer: Sub-Antarctic Whales and Whaling.

SATURDAY, MAY 17.

ROYAL INSTITUTION, at 3.—Dr. J. Wells: Cæsar's Personal Character as seen in his Commentaries.

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THURSDAY, MAY 15, 1919.

DYNAMICS OF EVOLUTION.

The Origin and Evolution of Life on the Theory of Action, Reaction, and Interaction of Energy. By Prof. H. F. Osborn. Pp. xxxi+322. (London: G. Bell and Sons, Ltd., 1918.) Price 25*s.* net.

"CONFESSION of failure," Prof. Osborn writes, "is part of the essential honesty of scientific thought." Wave after wave of evolutionary theory has prompted research, but, in spite of many new facts, there has been little fresh enlightenment since Darwin's day. "The chief causes of the orderly evolution of the germ are still entirely unknown." So the author has sought for a fresh starting-point—"an energy conception of evolution." He would take the organon of physico-chemical science for a while, leaving morphology and bionomics to the end. There are four main complexes of energy to be considered — the inorganic environment, the organism, the heredity germ, and the animate environment. How are they adjusted to one another? What in particular are the relations of the heredity germ with the other complexes, for are we not slow to learn Weismann's lesson that the essential question is as to germinal evolution, not as to bodily evolution? The heredity germ remains inconceivable as regards its development, its lineage, and its evolution. Thus, in his preface, Prof. Osborn cleans the slate. His essential honesty is a little depressing, but the general idea is: We have been thinking too much from Form backwards; let us try to think from Energy forwards.

Organisms as material systems are solidary with the inorganic, but they are distinguished by their more dominant constructive capacities, as Joly pointed out very clearly long ago. Besides the actions and reactions (capturing, storing, releasing energy) which conform to the second law of thermodynamics, there is in organisms a distinctive dominance of "interactions" which unify or integrate—*e.g.* nervous impulses or chemical messengers. "Interaction" has to do with the co-ordination, balance, co-operation, compensation, acceleration, and retardation of actions and reactions. In the course of development there is evidence of this correlating and regulating, which Prof. Osborn is not felicitous in calling "the directing power of heredity." The central thought of the book is thus stated: "In each organism the phenomena of life represent the action, reaction, and interaction of four complexes of physico-chemical energy, namely, those of (1) the inorganic environment, (2) the developing organism (protoplasm and body-chromatin), (3) the germ or heredity-chromatin, (4) the life environment. Upon the resultant actions, reactions, and interactions of potential and kinetic energy in each organism selection is constantly operating wherever there is competition with the corresponding actions, reactions, and interactions of other organisms." The author is quick to add that, "while this is a principle which largely governs the organism, it remains to be discovered whether it also governs the causes of the evolution of the germ." This is Prof. Osborn's "tetrakinetic" or "tetraplastic" theory.

The constructive part of the book opens with an interesting discussion of "the preparation of the earth for life," the capture of the sun's heat and light, the suitability of various elements to function in metabolism, and similar topics. As to the primary physico-chemical stages of life, the following steps are speculatively suggested: The assemblage of several of the ten elements now essential to life, the integration of these in a novel way ("a new form of unity in the cosmos") and in a state of colloidal suspension, the appearance and specialisation of catalysers (effecting biochemical co-ordination and correlation), the beginning of competition and natural selection. What primordial life-forms competed about we are not told; probably for a place in the sun. The attractive agency of hydrogen and oxygen led to the incorporation of additional elements useful in energy-capture. But no great progress was possible until interactions were established which regulated and unified metabolism; and a vivid account is given of the variety of chemical messengers, both general and specific, which play so important a *rôle* in the economy of the organism.

Prof. Osborn then passes to consider bacteria as the forerunners of ordinary plant and animal protists; they show the capture, storage, and utilisation of energy in simplest expression; they form the primordial food supply; they lead on to the first true cells with differentiated protoplasm and chromatin. Through the chromatin, excelling all other substances in the complexity of its molecular constitution, it became easier for an organism to retain its integrity amid ceaseless metabolism and from generation to generation. Another great step, with incalculably important results was implied in the appearance of chlorophyll, which hitched organisms in a new way to the sun, facilitating energy-capture enormously.

In the second part of his book Prof. Osborn deals with the evolution of animal form, and proves himself an entertaining and illuminating guide. What seemed to us in earlier pages an over-emphasis on the adequacy of physico-chemical formulations is now corrected by a recognition of psychic powers which are in an indirect way "creative of new form and new function." In the vivid sketch of the evolution of vertebrates there are very valuable features, notably (*a*) the correlation of organismal and environmental changes; (*b*) the illustration of adaptive radiation of group after group to the twelve chief habitats; (*c*) the continual facing of the difficulty that, unless one is a thoroughgoing Lamarckian, the sources of the raw materials of evolution must be looked for in the heredity germ, not in the organism; in the genotype, not in the phenotype; (*d*) the recognition of the simultaneous and cor-

related evolution of a multitude of characters in one organism (which is aptly likened to an advancing army with units, companies, and regiments); (*e*) the importance of what we venture to call temporal variations—*i.e. plus* and *minus* changes in the rate or *tempo* of the evolution of various parts of the body, which may perhaps be correlated with variations in glands of internal secretion; (*f*) the insistence on the palæontological evidence, which has accumulated since Waagen's day, thanks in great part to Prof. Osborn's own industry, that the evolution of characters often proceeds by minute and definite changes; and (*g*) what we confess to having an incorrigible pleasure in welcoming, an admission that the "initiative" of the organism counts. Prof. Osborn's concept of "interaction" does not seem to us to differ from the concept of "correlation" or "integration" with which many of us have worked, but perhaps he has done more justice to it than have others. At any rate, his clear view of the dynamical aspect of the organism has resulted in an uncommonly fresh and stimulating book which will make many students of biology grateful. We wish we had space for more than a word of praise for the abundant illustrations, which are very original and telling.

J. A. T.

EXPERIMENTS IN BIOLOGICAL METHOD.

(1) *The Quantitative Method in Biology.* By Prof. Julius MacLeod. ("Publications of the University of Manchester," Biological Series, No. 11.) Pp. xii+228. (Manchester: University Press; London: Longmans, Green, and Co., 1919.) Price 15*s.* net.

(2) *A Text-book of Biology. For Students in General, Medical, and Technical Courses.* By Prof. William Martin Smallwood. Third edition, enlarged and thoroughly revised. Pp. 306. (Philadelphia and New York: Lea and Febiger, 1918.) Price 10*s.* 6*d.* net.

AT intervals, in every science, investigators and teachers begin to become dissatisfied with accepted methods. They come to realise that the methods in vogue were adapted to a certain stage in the development of the science, and that as the science progresses changes both in the means of investigation and in the manner of teaching become needful. The two books under review have one feature, and perhaps only one, in common; they both are attempts to introduce improved methods, the one in investigation, the other in teaching.

(1) Prof. MacLeod, of Ghent, while resident at Manchester, has continued his studies on what might be called biometry were not his methods so different from those of the English school of biometricians, and expounds his aims for the benefit of British readers. He tells us that in the physical sciences "the properties of objects are measured and expressed by means of figures called *constants*," while in biology "the properties (characters) of the living things are usually described by means of terms" (long, short, narrow, oval, etc.). "The object of the present book is to describe a method by which biological constants may be established." He begins by assuming that there is a chemical basis for species, for the living basis of each species is a mixture of chemical substances, and these specific mixtures differ from one another by at least one entity. Species are thus essentially discontinuous, but every specific property is the resultant of a reaction between the specific mixture and environmental forces. Hence arises *plasticity*—the variation of species due to environmental differences. Variation due to plasticity and that due to germinal change can be investigated adequately only by quantitative methods, as is recognised by both the biometric and Mendelian schools. But exact methods are needed, especially in systematic biology, and also in embryology, comparative anatomy, and physiology, and it is suggested that many new facts and ideas would come to light if this were more generally recognised. For this purpose the author seeks in each species investigated a number of simple properties, analogous with Mendelian unit characters, which can be observed and recorded accurately. These he calls *primordia*, and they are such that each is the expression of a state of equilibrium at the time when it is observed, though it may disappear or change to a different primordium later. For example, the petals of the forget-me-not are first white, then pink, then blue; white and pink are transitory primordia, blue is persistent. Most primordia chosen are measurable—lengths, numbers of segments, and so forth—but such features as colour or texture may also be used.

By means of the study of such primordia, made by the author chiefly in plants and insects, a number of principles are deduced, with which all biologists are familiar in an indefinite sense, but which are rarely expressed in a concrete form. Of these may be mentioned especially *gradation*, defined as the variation of a given property along a given axis (as, for example, the lengths of successive internodes in plants), and also a number of curious and ingenious comparisons between organic variation and the numerical results of chance in regard to the tossing of coins, throwing of dice, etc.

The main aim of the book, however, is to show that by making sufficient measurements of independently varying "primordia" true biological constants are obtained. For if a sufficient number of specimens are examined (and the author shows that this number need not be excessively large), the maximal, and sometimes also the minimal, value of each primordium is "a strictly determined biological constant," so that a collection of such constants is not only an adequate and easily used diagnosis of the species, but may be used also for the study of development, comparative anatomy, and the influence of environment (plasticity). Though the book contains much that is

interesting, a large part of it affords but tedious reading; somehow it suggests that organisms looked at in this light are not, and never have been, *alive*. That we should learn much if Prof. MacLeod's method were adopted is probably very true, but it is difficult to imagine any large number of biologists adopting it.

(2) Prof. Smallwood's "Text-book of Biology" is of a very different character. It is an introduction to biology for elementary students, planned so as to retain the main features of the "type" system, while at the same time offering a much wider outlook on the subject than is given by most other books of the kind. It has reached a third edition, and therefore doubtless meets a real want, and yet it cannot be called satisfactory. In 300 pages largely occupied by figures, mostly very good, it attempts to treat almost every known aspect of biology, and the impression given is "a little of everything and not enough of anything." A good elementary text-book based on biological principles rather than on types is certainly much to be desired, but it will not be easy to write, and the volume under notice, though an attempt in that direction, is by no means an unqualified success. L. D.

INDUSTRIAL ELECTROLYSIS.

The Applications of Electrolysis in Chemical Industry. By A. J. Hale. (Monographs on Industrial Chemistry.) Pp. ix + 148. (London: Longmans, Green, and Co., 1918.) Price 7*s*. 6*d*. net.

THIS is one of the volumes of the series of "Monographs on Industrial Chemistry" now being published under the general editorship of Sir Edward Thorpe. The author is demonstrator and lecturer in chemistry at the Finsbury Technical College; his book is well printed and illustrated, and contains copious references to the patent and other literature of the subject.

The work is divided into an introduction and eight chapters. The introduction and chap. i. (thirty-two pages in all, or two-ninths of the book) are devoted to the discussion of the general principles of electrolysis and methods of generating the current; the remaining seven chapters, extending to 111 pages, have to suffice, therefore, for the special subject with which the book deals—namely, industrial electrolysis. The compression required to cover the ground in the allotted space is, in fact, rather too severe a handicap for adequate treatment, and the book would have gained in value had its length been doubled. As it is, two chapters have been given to the extraction and refining of metals, and two chapters to the electrolysis of alkali chlorides; while one chapter each is devoted to the electrolytic production of the gases hydrogen and oxygen, of inorganic colours, and of organic compounds such as iodoform, anthraquinone, etc.

The description of particular processes and cells is necessarily brief, and in the circumstances the author would have been wise to devote less space to the earlier patents and processes of electrolysis (many of them no longer in operation), and to give more detailed descriptions of the processes and cells now in actual use. For example, the Acker process of caustic soda manufacture by the electrolysis of fused salt has not been a success as a practical process, yet the author has devoted nearly two pages and two illustrations to his description of it, and some of the other cells and processes dealt with are similarly only of historical interest.

As Sir Edward Thorpe pointed out in his general introduction to the series of monographs to which this volume belongs: "In some cases, where the subjects touch the actual frontiers of progress, knowledge is so very recent, and its application so very tentative, that both are almost certain to experience profound modification sooner or later. This, of course, is inevitable." It is a pity that the author has increased this handicap of "being out of date before it appears" by including matter in the present volume that is only of historic value.

However, the work will prove of considerable value to students of electro-chemistry who wish to obtain a rapid survey of its industrial applications, and also to engineers and chemists who wish to trace the development of particular processes. As already stated, there are copious references to the earlier journal and patent literature, and good subject-matter and name indexes, which add to the value of the book as a reference work on the subject with which it deals. J. B. C. K.

OUR BOOKSHELF.

America at School and at Work. By the Rev. Dr. H. B. Gray. Pp. xx + 172. (London: Nisbet and Co., Ltd., 1918.) Price 5*s*. net.

THIS is a highly valuable contribution to the solution of present-day educational problems. Dr. H. B. Gray was joint author with Mr. S. Turner of a stimulating book issued in 1916 entitled "Eclipse or Empire?" The present work is the fruit of an extensive tour in the United States during the spring and summer of 1917, especially among the educational institutions of the prosperous States of the Far West least affected by European influences, and is a remarkable revelation of the spirit of enterprise shown by these States. The author is unstinting in his praise of the "magnificent and far-reaching measure" known as Mr. Fisher's Education Act of 1918, from the operations of which he anticipates the most fruitful results for the future well-being of the nation.

America has a tremendous problem to face—namely, to turn into good American citizens in the shortest time possible the great stream of immigrants which annually comes to its shores from all parts of the European world, and the instrument by which this salutary result is accomplished is chiefly the English language, the medium for

which is the elementary or grammar school, the high school and the technical schools, and finally the college or the university. "Education is designed for the masses, and not for the classes," so the author writes, and "it is the birthright of every citizen." And so education becomes to the American youth his one inalienable asset. The author contrasts the enormous provision made in the States with that made in this country in the way of private benefaction and Government, State, and city grants, not only in aid of general education for all classes, but also in the means of continued education and the support of research as applied to agriculture and manufacture, and especially refers to the great industrial and commercial corporations which provide means for the thorough education of their apprentices.

The book is full of most interesting examples of the varied ways in which education for, and during the preliminary stages of, a vocation is made accessible. Administrators of education will find the book both a useful guide and a much needed stimulus.

Catalogue of Lewis's Medical and Scientific Circulating Library, including a Classified Index of Subjects, with the Names of those Authors who have treated upon them. New edition, revised to the end of 1917. Pp. 492. (London: H. K. Lewis and Co., Ltd., 1918.) Price 12*s*. 6*d*. net.

THIS library catalogue is in two parts. A list of the books arranged in the alphabetic sequence of the authors' names occupies the greater part of the volume, and is followed by an alphabetical list of subjects. In the author index the title of each book, its published price, and date of publication are given. Although the published price may give some idea of the size of a book, it would improve the catalogue if the number of pages in each case were stated. We would also suggest that for indicating the size of pages an approximate statement of the height and width of the page in inches or centimetres is more useful as well as more accurate than such expressions as 12mo, cr. 8vo, and roy. 8vo.

The second part of the catalogue is its most interesting feature. This is an alphabetical list of subjects, the cross-references to the main list of books being merely the names of authors. Thus under "Molecules" we find Kelvin and Turner. Turning to the author index, we are led to Lord Kelvin's lectures on "Molecular Dynamics" and to W. E. S. Turner on "Molecular Association." As there are thirteen Turners in the list, it would have been better to give the author's initials in the subject catalogue. Indeed, this should be done whenever there are several authors with the same surname.

Although this catalogue has been compiled for a particular library, it will be helpful to those who are forming libraries of their own, the list of modern scientific books in the English language being very comprehensive.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

"Camouflage" of Ships in War.

IN his speech at the Royal Academy banquet the Prince of Wales referred to one of the factors of modern warfare which is of special scientific interest—the art of "camouflage." In the highly successful "camouflage" of ships as it was carried out during the closing phases of the war the principle made use of was that, familiar to biologists, of breaking up continuity of surface and outline by violent colour contrasts.

I happened to have become specially interested in this problem of the "camouflage" of ships long before the war through a peculiar concatenation of circumstances:—(1) I was professionally interested as a biologist in the obliterative colouring of animals; (2) during my sojourns in the Gran Chaco during the years 1889–91 and 1896–97 I had had the extraordinary efficiency of Nature's methods of obliterative colouring constantly brought home to me by practical experience; and (3) when present at the opening of the Kiel Canal in 1895, as one of the crew of Mr. W. B. Hardy's yacht *Raven*, I was particularly impressed by the fact that, whereas the ships of the British squadron attending the festivities retained their beautiful colouring of cream funnels and black hulls, the French and German warships, on the other hand, had adopted an obliterative colouring of uniform grey—the shade differing somewhat in the two cases.

During more recent years, holding a consistent belief in the impending war, I continued to interest myself practically in the principles underlying the visibility of ships at sea and the possibility of successful "camouflage." After the outbreak of war, on my return to Glasgow in September, 1914, I proceeded to endeavour to impress upon the Admiralty the conclusions at which I had arrived. These were briefly:—

(1) That while it was not suggested that a ship at sea under average conditions could be rendered *invisible* in the strict sense, yet, on the other hand, it was quite feasible (*a*) to diminish greatly the conspicuousness of a distant ship, and (*b*) to stultify the enemy's range-finders by confusing the details—such as, above all, vertical lines—of which they make use. It is unnecessary to recall that in range-finding as applied to ships at sea there are two factors involved: (*a*) the determination of distance, and (*b*) the determination of the rate and direction of relative movement.

(2) That of the various methods which Nature makes use of in her obliterative colouring of animals there were two alone of practical value for application to ships: (*a*) the contrast colouring already alluded to, and (*b*) the method of compensative shading—the obliteration of relief by counteracting the light and shade to which the appearance of relief in large objects is mainly due. This latter method is simply the application of the great principle of animal coloration which owes its recognition to the distinguished American artist, Mr. Abbott H. Thayer.

I urged upon the Admiralty that, as a protection against long-range gunfire, these two basic principles should be applied to the colouring of ships. The hull and the upper works were, as a preliminary, to be treated on the Thayer principle, dark shadows being lightened and high lights darkened, and then the main protection applied in the form of strongly con-

trasting pigments, the boundary lines between the colours running uninterruptedly across boats, guns, turrets, etc. Of course, precisely the same principles apply to ships viewed through the periscope of a submarine, but in these early days of the war the submarine menace had not yet become insistent. The main principles outlined above were duly recognised by the Admiralty, one of my letters on the subject written in September being circulated to the Fleet early in November, 1914. Most unfortunately, their carrying into effect was left to the responsibility of the naval officers immediately concerned, without any scientific or artistic supervision. The result was a complete absence of system, and an effect in individual cases calculated to excite, according to one's temperament, derision or tears. In the summer of 1915 I was informed that the principle of parti-colouring had been given up, that the Admiralty had now arrived at a definite decision as to "the most serviceable scheme of colouring for H.M. ships," and that this scheme was one of *uniform* coloration.

I continued to press on the Government—incidentally making myself rather a nuisance to some of my friends—that a system of uniform colouring was *not* the right one, whether applied to ships or to service dress; that of all uniform colours the very worst, whether by day or night, was the black which was then still in use for destroyers, and so on. I also kept on urging that the only way of obtaining really satisfactory results was to place the whole matter of ship "camouflage" under the direction of one individual endowed with practical knowledge of the sea and ships, artistic sense, and grasp of the scientific principles involved.

At last, during the summer of 1917, I had the satisfaction of seeing the principle of parti-colouring come into its own. Discarded by the Admiralty as useless two years before, the value of the principle was now recognised and its application entrusted to skilled hands. Glaring defects which were at first conspicuous were remedied, and the later efforts, such as the great aeroplane-carrier, H.M.S. *Argus*, left little opening for criticism.

The importance of the subsidiary principle—that of compensative shading—as an aid in "camouflage" was, unfortunately, never fully grasped during the course of the war. The distinguished expounder of this principle, Mr. Abbott H. Thayer, was in the strongest sympathy with the cause of the Allies, and I think it a great pity that it was not found possible to enlist his practical help, which I feel sure would have been gladly and freely given.

It is only fair to state, in conclusion, that in my personal communications upon this subject I laid stress upon the use of parti-colouring as a means of rendering ships less conspicuous. I also directed attention to its use in confusing the details, especially vertical lines, which are made use of by the enemy's range-finders, but I did not lay sufficient emphasis on this. Actual experience has shown that in submarine warfare this second function—in particular, determination of the factor of relative movement—is of overwhelming importance. But this does not affect the main point I desire to make, namely, that the leading principle underlying ship "camouflage"—the breaking-up of the form of a vessel by strongly contrasting colours—is one familiar to biologists; that it was made known to the Admiralty in the early days of the war, although its carrying into practice was, unfortunately, bungled; and that consequently newspaper paragraphs which date the discovery of the principle, instead of the more efficient application of it, from the year 1917 are distinctly misleading.

J. Graham Kerr.

University of Glasgow, May 6.

A Possible Case of Partial Sterilisation in Soil.

When on active service in France in 1918 I had, partly as a hobby and partly for food supplies, a garden on the site of an old brickyard. The land had been waste land for certainly three years, and I believe more. It received a light dressing of dung in February and was dug up in that month; seeds were got in in March. In April or May the land received by chance a light top-dressing of a mixture of charcoal and brick-earth impregnated with potassium carbonate and hexamethylene tetramine. The crops obtained were, in my opinion, abnormally good, and much better than those obtained by some French gardeners on cultivated gardens near by. The chief crops grown were potatoes, dwarf peas, and dwarf beans; the two last gave the best results in the order named. It is not asserted that the top-dressing brought about this result, as the history of the soil is necessarily rather obscure; and as it was not designed as a scientific experiment there was no control plot, but it seems improbable that the small amounts of nitrogen and potassium supplied by it could have made the garden much better than neighbouring ones.

The suggestion is offered that the hexamethylene tetramine may have liberated formaldehyde by the action of dilute acids in the soil and caused partial sterilisation.

I have since subjected to steam distillation (*a*) a solution of hexamine, (*b*) untreated soil, garden soil, and (*c*) garden soil moistened with hexamine solution. Schiff's reagent gave negative results in the case of (*a*) and (*b*), but positive results with (*c*).

F. Knowles.

The Midland Agricultural College, Kingston, Derby.

MINERAL PRODUCTION IN RELATION TO THE PEACE TREATY.

It is gradually becoming more and more clear, as the history of the Great War is further examined, that one of the main objects of Germany in attacking her neighbours was commercial aggrandisement by destroying rival manufactories and by appropriating the raw material of industry wherever it lay conveniently situated for that purpose, this raw material being in the first instance all available mineral wealth. She had already done this with supreme success in 1871; the iron-ore fields of Lorraine then wrested from France had formed one of the mainstays of Germany's industrial development, and she fully expected that the new war would yield proportionately valuable results. This was Germany's avowed policy; in the words of one of the acknowledged German authorities, Frederick Naumann, the object of a country nowadays in going to war is purely "to benefit the economic development of the country," and German writers have ever since the commencement of the war announced their fixed determination to retain in German possession the iron-ore fields of French Lorraine, thus giving Germany "the practical monopoly of iron-ore in Europe," and assuring her of victory in the future wars to which she was already looking forward.

Until the actual boundaries, as roughly defined in Sections II. and III. of the Peace Treaty, have been accurately settled, it is only possible to form

a general idea of the extent to which Germany's mineral production will be diminished by the territory of which she is to be deprived. Naturally, the first mineral to be considered is coal. In 1913 Germany produced rather more than 190 million tons of coal, of which about 100 millions came from the Westphalian coalfields, 34 millions from Upper Silesia, and 15 millions from the Saar coalfield. So far as can be seen from the Peace Treaty, Germany is to cede to France the whole of the Saar coalfield in compensation for the destruction of the coalfields of Northern France; seeing that the Pas de Calais district produced in 1913 about 22 million tons of coal, and the Nord district about 8 millions, or approximately double the output of the Saar basin, the compensation thus afforded does not err on the side of liberality. It is therefore to be hoped that under Section VIII. Germany will be compelled to deliver over to France as much coal as will bring the total coal supplies of the latter up to at least her pre-war standard until her northern collieries are again fully equipped and in working order.

It appears certain that a considerable proportion of the Silesian coalfields will be ceded to Poland, though how much is by no means settled as yet. It is important that Poland should have ample coal supplies in order that its industrial development may be free and unhampered by any dependence on its neighbours for this indispensable material. Even were the whole of the Silesian coalfields to pass into Polish hands, Germany would still have an output equal to three-fourths of its pre-war output in bituminous coal alone, whilst if lignite is included in the calculation, as it really should be, the annual output of Germany will only be diminished by about 18 per cent.

The restoration of Alsace-Lorraine to France affects two important deposits of minerals—the iron-ores of Lorraine, and the potash deposits of Alsace. In 1913 Germany produced nearly 36 million tons of iron-ore, of which no fewer than 28½ millions were minette ore, more than 21 million tons being produced in Lorraine. It is to be hoped that in the detail of the clauses under which Germany renounces her treaties with Luxembourg conditions will be included that will favour the delivery of the Luxembourg minette to Belgium rather than to Germany. Few things would do more to restore the great iron industry of Belgium, which Germany set herself to destroy with the most brutal deliberation, than such an arrangement as would give Belgium preferential treatment in the matter of this ore. It will be seen that even without any minette Germany will still have an annual production that could easily be brought up to 10 million tons of iron-ore, or, say, 5 million tons of pig-iron, as against 14 million tons in 1913. This production would be ample for the industrial needs of the German nation, though not for the huge output of munitions of war of all kinds for which so much had been employed in the years preceding 1914, and such a drastic reduction of Germany's output of iron is the best guarantee possible for a world peace, and the easiest and safest means of protecting France from any future attempts of German aggression.

The restoration of Alsace to France implies the shattering of the German monopoly in potash salts, upon which she was relying for forcing other nations to trade with her. To quote from an article in a leading German paper written towards the end of 1917: "The Alsace potash beds are amongst the richest that have ever been found. If these deposits passed into the hands of the enemy, it would be the end of the German monopoly of potash. . . . We need not point out what would follow for our own potash industry and of what a financial weapon the enemy would deprive us" (see *Journ. Soc. Chem. Ind.*, November 15, 1918). In 1913 Germany was producing about 11 million tons of potash salts, containing about 1 million tons of pure potash. The Alsatian deposits are much purer, needing in many cases no refining, and much richer, averaging 22 per cent. of potash, and it is calculated that the entire deposit, as at present known, contains more than 300 million tons of potash, or enough by itself to supply the requirements of the world for many years. So jealous were the older companies that composed the Potash Syndicate of Central Germany of the greater potential value of the Alsace deposits that they allowed the latter only an output equal to 5 per cent. of the total German output. Several companies are, however, operating already in the Alsatian field, and it may be confidently expected that the next few years will see such vigorous developments that all the needs of the Allies can be supplied therefrom. Until this can be done, presumably the Germans will be called upon to supply such potash minerals as we may need; it would probably be better that they should be made to furnish the raw mineral than the purified product; the refining in this country will keep our chemical works busy and provide employment; exporting the raw material will also employ usefully the tonnage taking foodstuffs, etc., to Germany, and prevent the Germans from using those ships for exporting to us competitive articles of manufacture.

This general review of the Peace Treaty so far as it bears upon mineral production shows, therefore, that it has been conceived in no oppressive or illiberal spirit. Restitution to France of the iron and potash deposits taken from her in 1871 is but bare justice; the reparation of the damage done to the French coalfields by the cession of the Saar coal basin is a partial compensation for the injuries inflicted on French industry, and the transfer of the Silesian coalfields to Poland is necessary in order to secure to that nation an independent economic existence. It may be suggested that Belgium is entitled to somewhat more in the way of minerals than it appears to be receiving, but apart from this it is to be hoped that the conditions set out in the Peace Treaty represent the irreducible minimum to which the Allies will agree.

H. LOUIS.

THEORY OF BOWED INSTRUMENTS.[1]

DIFFICULT as the violin may be to play, there are many who play to one who experiments upon it scientifically; and, scarce as the experimentalist may be, the successful theorist is yet scarcer. But we have now before us the first part of an elaborate investigation in which mathematical theory and confirmatory experiments happily alternate. Important and interesting results have already been reached, and others equally so are likely to follow, thus clearing up a number of points which have hitherto been obscure.

Helmholtz was able to show, by his vibration

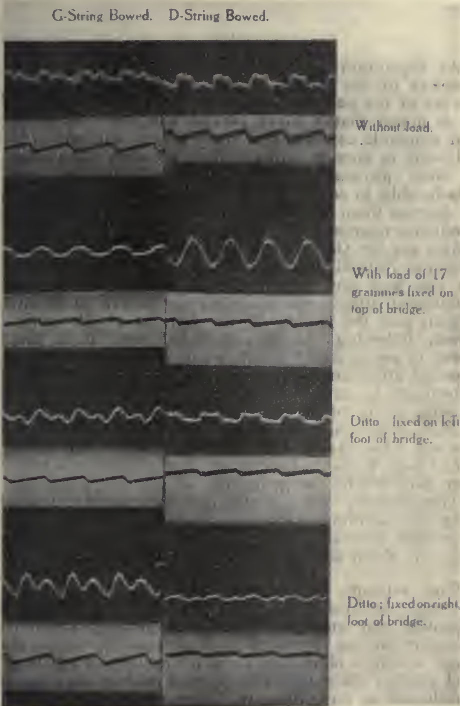

FIG. 1.—Simultaneous vibration-curves illustrating effect of loading the violin bridge on its horizontal motion transverse to the strings (observed at the G-string corner).

microscope, that the bowed point of a violin string might execute a motion the graph of which is a two-step zig-zag. He also surmised that the forward speed of the bowed place of the string equalled that of the bow when a good tone was obtained. From this experimental two-step zig-zag Helmholtz proceeded to his theory of the well-bowed string.

F. Krigar-Menzel and A. Raps photographed (upon a film on a revolving drum) various points of bowed strings, and so obtained much information on the subject of the vibrations possible to the strings themselves.

Prof. E. H. Barton and his students took simultaneous photographs of the behaviour of the strings and of the bridge, belly, or air of a monochord and of a violin. But in none of the foregoing cases was a direct *mechanical theory* of the string, bridge, etc., attempted. This has now been accomplished by Prof. C. V. Raman.

The equations of motion of the string are written and solved for the case of a periodic transverse force applied by the bow at a given position. The equations of motion of the bridge are next written and dealt with. Then follow photographs of simultaneous vibration-curves of belly and G-string of a violoncello at the "wolf-note" pitch, showing cyclical changes of amplitude. The *modus operandi* of the bow is next examined, and a simplified kinematical theory of the bowed string based upon it. This leads to a number of types of vibration: two-step, three-step, etc., zig-zag motions appearing in the corresponding graphs.

Another very interesting subject is that of the effect of the *mute*, which, by loading the bridge, enfeebles and veils the tone of the instrument. To investigate this effect, loads were placed in different positions on the bridge of a violin, and simultaneous vibration-curves of string and bridge taken. The results for the G-string and D-string are here reproduced (Fig. 1), the dark zig-zag line on light ground giving the displacement-time graph of the string, the light wavy line on black ground being the graph of the bridge's horizontal motion transverse to the string. Similar results were obtained for the other two strings.

Other points dealt with in the present instalment of the investigation are the effects of the variation of pressure and velocity of bowing, the relation between pressure and speed, and the vibrations obtained from a 'cello when played pizzicato.

The paper contains twenty-eight text figures and twenty-six full-page photographic reproductions, many of them of distinct beauty and instructiveness. All these should be consulted in the original by those interested. Indeed, the entire work well deserves careful study, presenting, as it does, a valuable contribution on the subject of bowed instruments.

[1] "On the Mechanical Theory of the Vibrations of Bowed Strings and of Musical Instruments of the Violin Family, with Experimental Verification of the Results." Part i. By C. V. Raman. (Bulletin No. 15.) Pp. iii+158. (Calcutta: The Indian Association for the Cultivation of Science, 1918.) Price 3s. 4d.

STATISTICS OF SYNTHETIC DYES.

IT was pointed out, in an article in NATURE for November 21, 1918, that one of the first things which ought to be done in efforts to resuscitate the dye industry in Great Britain is to survey the whole field of dyes and intermediate compounds, so as to determine the source of supply, to ascertain more precisely the needs of the community, both for home purposes and for export trade, to concentrate attention on the

production of indispensable colours, and to prevent waste of energy and material on the manufacture of the less important of these products. We now learn from a report issued by the Commissioner for Dyes (Sir Evan D. Jones) that an attempt in this direction was made so early as September, 1914, by a committee of the Society of Dyers and Colourists. This attempt, however, was not successful in securing the information so desirable in the interests of both manufacturers and users.

Nothing further was done until 1916, when an influential committee was formed, and, after a number of meetings at the Board of Trade, a list of the necessary dyestuffs was drawn up. The committee was at that time unable to make any progress in allocating the manufacture of these dyestuffs among British manufacturers. Many changes have, however, taken place since that time, and such movements as the amalgamation of Levinstein's with "British Dyes" is a step which must have facilitated progress towards this very desirable understanding among manufacturers. On the appointment of the Commissioner in June, 1917, a renewed effort was made to compile a census, and, with the assistance of Mr. W. E. Kay, representing the Calico Printers' Association, Ltd.; Mr. Christopher Rawson, of the British Cotton and Wool Dyers' Association, Ltd.; Mr. Thorp Whitaker, of the Bradford Dyers' Association, Ltd.; and Mr. Ernest Bentz, of the English Sewing Cotton Co., Ltd., this has now been done.

The report (dated November 1, 1918) shows the quantities of synthetic dyestuffs imported into this country during the year 1913. These statistics have been prepared from returns supplied by the representatives of the importing firms, and agree substantially with the figures for the total imports into this country during that year. The census has been compiled from the dyer's point of view rather than from that of the dye manufacturer, and the dyes have been classified according to their dyeing qualities, and not according to their chemical constitution. The difficulties of classification have been considerable, owing to the variety of distinctive names and the fact that many of the colours are mixtures. The accuracy of the amounts stated varies in certain cases, and as regards some colours the figures understate the actual colour consumption in the country. This necessarily arises from the fact that the list gives the importations for one year only, and more accurate figures could not be secured except by taking the average of a series of years.

The summary shows that in 1913 the total weight of dyestuffs imported amounted to 40,071,368 lb. The great majority came from Germany. Switzerland supplied important, though relatively small, amounts of dyes of all colours. These are, however, not shown in detail, as the facts were supplied in confidence by Swiss manufacturers, and the totals of each class can alone be given.

Section xii. contains an interesting list of intermediate products, such as naphthols, naphthylamines, the nitranilines, phenylglycine, resorcine, etc., which are not dyes, but are necessary to the production of dyes, as well as other products.

It is hoped that the census will serve among other things as a useful guide in estimating the requirements of the colour-using industries, and form a basis for determining the capacity of plant which it may be necessary to erect. In the present census about 10,000 colours are enumerated, but these do not represent nearly so large a number of individual colouring matters.

NOTES.

AN expedition left this country recently, under the auspices of the Royal Society, to make a scientific survey of the pastoral peoples in East Central Africa. It is hoped that a more careful study of the social and economic conditions of these people will add considerably to science, while a more accurate knowledge of their physical conditions, mental abilities, and relationship to each other will enable those concerned to develop them so that they may become useful and profitable members of the Empire. The tribes to be visited are the Gallas near Mombasa, the Kikuyu and Masai at Nairobi, the Ziba and Watuturu near Bukoba on the west and south-west of Lake Victoria, the Bahima of Ankole, the Banyoro, the Bagesu on Mount Elgon, and the Gallas on the frontier of Abyssinia. Then, following the Nile to Khartoum, it is proposed to see as many Nilotic tribes as possible, paying especial attention to the Banyuli and Badamu. The expedition is under the direction of the Rev. John Roscoe, rector of Ovington, formerly for many years C.M.S. missionary in Uganda. Mr. Roscoe sailed in the s.s. *Clan Menzie* on April 15, and will be away for at least a year. The funds for the expedition have been provided by the generosity of Mr. P. J. Mackie, of Glenreasdell. The Royal Society was asked to undertake the administration of Mr. Mackie's gift, and appointed a committee to control the expedition with Prof. A. Keith as chairman.

THE retiring president of the Chemical Society recently described to the members how British chemists had managed greatly to outstrip German chemists in the technical preparation of "mustard gas," which is obtained by the interaction of ethylene and sulphur chloride. The method devised was communicated to our Allies in France and in America. An article on the United States Chemical Warfare Service, appearing in the *Scientific American* for March 29, shows what was being done in that country as regards this and other "poison gases" when active hostilities ceased last November. During the winter of 1917–18, as a result of the growing importance of gas warfare and of the representations made by British and French officials, the United States authorities decided to erect a very large chlorine plant. The site selected was largely farm land under cultivation, so that housing accommodation had to be erected and transport facilities provided before a start could be made. By July the chlorine plant, designed to produce 100 tons per day, was ready to deliver chlorine, but the chemical installation for working the gas up was not so far advanced, and did not begin operations until September. Nevertheless, at the close of hostilities the staff had developed the gas-making facilities

at such a rate that they could produce more than 100 tons of "poison gas" daily, and, but for the armistice, that quantity would have been doubled by the beginning of the present year. What this would have meant may be understood when it is stated that the total output of "poison gas" from the German factories was only thirty tons per day. Indeed, as regards the "mustard gas" itself, it has been learned since the armistice that the largest daily quantity the enemy could manufacture was from six to eight tons, or only about one-fourth of the amount which the American chemists alone were producing in November.

THE RIGHT HON. SIR JOHN H. A. MACDONALD (Lord Kinsburgh), F.R.S., who died at Edinburgh on May 9 in his eighty-third year, was keenly interested in science, and joined the Institution of Electrical Engineers shortly after its foundation. He was educated at the Universities of Edinburgh and Basle. Called to the Scottish Bar in 1859, Sir John Macdonald soon obtained considerable success in his profession, and during a long and distinguished public career filled many important positions. He held the office of Solicitor-General for Scotland during the years 1876–80, and four years later became Lord Advocate. Whilst holding the latter office he sat in Parliament as Member for Edinburgh and St. Andrews Universities (1885–88), and carried through the House of Commons an Act which introduced considerable reforms in Scottish criminal administration. In 1888 Sir John Macdonald was appointed Lord Justice-Clerk of Scotland and Lord President of the Second Division of the Court of Session, an office which he held until 1915. Early in his career he interested himself actively in the Volunteer Force, and served in it for many years, during which he continuously and persistently strove to bring about reforms in drill and tactics; eventually the majority of his suggestions were adopted by the military authorities. Sir John published numerous books and other works on matters relating to electricity, law, and tactics, and many medals and diplomas were awarded to him in connection with his life-saving and electrical inventions.

A LARGE and distinguished gathering assembled at the Guildhall on the evening of May 8 at the jubilee banquet of the Iron and Steel Institute, founded in 1869. M. Eugène Schneider, the president, occupied the chair, and read messages from the King and the Prince of Wales wishing prosperity to the institute. In proposing the toast of "Peace, Progress, and Prosperity," the president referred to the moral situation of the Allied nations, especially the British and French, who were bearing on their shoulders the main burden of peace. He said that the task of men of good will was made more difficult by short-sighted folk who imagined that they possessed an infallible nostrum, a special device which held in every case and in every circumstance. The mass of French and British working-men, however, instinctively distrusted "day dreams." They looked forward to a satisfactory social order without revolutionary crises and civil wars. Was the task impossible? Some master-builders would be able to rear a new edifice wherein every tenant would find pleasure to live, provided social problems were dealt with by those who were worthy of the title "leaders of men." Discussing the future relations between employers and employed, the president emphasised that these can be satisfactorily brought about only by educating both classes. Future captains of industry must learn to know their own men, and working-men must be able to judge their employers otherwise than by hearsay. Future engineers must include in their training a few months' probation in the workshops as ordinary working-men, and not lose the benefit of mingling with them.

THE U.S. National Academy of Sciences held a very successful annual meeting at Washington on April 28–30. Many of the subjects discussed dealt with the war, while other papers presented recent developments in pure and applied science. The academy is the scientific adviser of the United States Government, co-operating with the different Departments and Bureaux in the execution of the more practical developments. Another function is the representation of the United States by academy members in international affairs, some of the members having served as foreign scientific attachés in Europe during the war. The most important of the allied branches of the academy is the National Research Council, which body has carried on some very valuable work for the War and Navy Departments, particularly relating to submarine defence, nitrate supply, radio communication, ordnance, wireless control, searchlights, etc., features of which were described during the recent meeting. At the annual dinner of the academy, held on April 29, gold medals were presented to Prince Albert of Monaco and Prof. Charles Fabry, of the University of Marseilles, for their contributions to the advance of science. Dr. Charles D. Walcott, president of the academy, made the presentations. The award of the Henry Draper gold medal to Prof. Fabry was made for his notable investigations in the science of astronomical physics, particularly his researches in connection with the light of the sun and other astral bodies; while the original contributions of Prince Albert of Monaco on oceanography received the highest recognition of the academy in the form of the Alexander Agassiz gold medal, established through funds provided by Sir John Murray. This is the second award of the Agassiz medal, the first having been presented to Dr. Johan Hjort, of Bergen.

A NEW American Arctic expedition proposes to start in a few weeks to explore the untraversed part of the Arctic Ocean between Bering Strait and the North Pole. The expedition, which was postponed a few years ago, is to be under the leadership of Capt. R. A. Bartlett, and will be supported by the Aero Club of America. The *Geographical Review* for March (vol. vii., No. 3) gives some details of the plans. Flying bases are to be established at Cape Columbia on Grant Land, at Cape Chelyuskin in Siberia or on Nicholas Land to the north of it, and at Wrangel Island. The expedition will have a large aeroplane capable of making the flight of more than 1100 miles from Cape Chelyuskin to the Pole, and several smaller aeroplanes for shorter flights. The main base of the expedition will be at Etah, in Greenland. In addition to the vessels required to establish the bases, it is proposed to send a small vessel through Bering Strait and force her into the pack in the hope that she will drift across to the European side of the Arctic Ocean, thus emulating Capt. R. Amundsen in his expedition now in progress. Capt. Bartlett's expedition is planned to take three years.

IN spite of the chaotic conditions in Russia, a new hydrographical expedition to the seas north of Siberia is being planned by the Russian Hydrographical Department. From *La Géographie* (vol. xxxii., No. 4) we learn that the expedition will be divided into two parts: one under Comdr. Vilkitski will work between the White Sea and Cape Chelyuskin, the other under Comdr. Novopashenni between Cape Chelyuskin and Bering Strait. The coasts are to be surveyed, coastal waters sounded, and ice conditions studied throughout a whole year. It is also proposed to set up several meteorological stations fitted with wireless telegraphy. The sites suggested are at White Island (off Yamal), the north of Novaya Zemlya, Obdorsk, Cape Chelyuskin, the mouths of the Lena and the Kolima, the

New Siberia Islands, and Koliuchin Island. These stations will co-operate with those already existing at Yugor Strait, Cape Mare Sale (Yamal), and Dickson Island (Yenisei). Attention is to be paid to economic conditions and the possibilities of trade.

SIR EDWARD SHARPEY SCHAFER writes that the remarks made in a note in NATURE of May 1, p. 173, with reference to his address on "The Position of Physiology in Medicine" is apt to give the impression that he would favour a plan of allowing the student to see something of hospital work at the commencement of his course. We regret the possibility of this misunderstanding. The suggestion was made as an attempt to remedy the admitted difficulty of convincing the student of the value of physiology. Sir Edward Sharpey Schafer, on the contrary, contends that it is a positive disadvantage to give any premature attention to clinical medicine and surgery; and that it is not only useless for understanding these subjects, but also fatal to the attainment of a proper grasp of physiology, which must, in the first instance, be studied as a pure science. We are glad to have the opportunity of making his position clear.

PROF. G. ELLIOT SMITH has been elected president of the Manchester Literary and Philosophical Society.

THE ninth annual May lecture of the Institute of Metals will be delivered by Prof. F. Soddy on "Radioactivity," at Caxton Hall, Caxton Street, Westminster, on Monday, May 19, at 8 p.m.

SIR NAPIER SHAW has resumed the administrative duties of the directorship of the Meteorological Office, from which he was relieved in May of last year by the appointment of Col. H. G. Lyons to be acting director for the period of the war.

IN connection with the fifty-sixth annual meeting of the British Pharmaceutical Conference, which is to be held in London on July 21–24 inclusive, there is to be a memorial lecture as a tribute to the memory of the late Lt.-Col. E. F. Harrison.

WE are asked to state that, in compliance with a suggestion by the Ministry of Labour, Appointments Department, the library and reading-room of the Society of Engineers (Incorporated), 17 Victoria Street, Westminster, S.W.1, have been placed at the disposal of officers at present looking out for appointments in the engineering and allied professions. All such officers are also cordially invited to attend the ordinary meetings of the society, particulars of which may be obtained on application to the secretary.

DR. FERDINAND G. WIECHMANN died recently in New York at the age of sixty. He was an instructor in chemistry at Columbia University from 1883 to 1897, since which time he had been mainly occupied as a consulting research chemist. He was a specialist in the chemistry of sugar, and had written largely on that subject.

THE Smithsonian Institution at Washington has announced that the studies carried on at Calama, in Chile, and Mount Wilson, in California, with regard to solar radiation and its effect on weather conditions have proved so satisfactory that it contemplates establishing three or four additional observing stations in widely separated and almost cloudless regions, such as Egypt, India, South Africa, and Australia. It is reported that the weather forecasts of the Government of Argentina are now based on observations made at the Calama station.

THE death is announced, in his eighty-sixth year, of Prof. Charles Brinckerhoff Richards, who was professor of mechanical engineering at Yale from 1884 to 1909. Prof. Richards was frequently called upon by the American Government as an expert adviser, and in 1889 was U.S. Commissioner to the Paris Exposition to report on all mechanical exhibits. He was made a Chevalier of the Legion of Honour for his invention of the Richards steam-engine indicator. Prof. Richards edited the engineering and other technical words in Webster's International Dictionary.

BY the death of Mr. G. M. Apsey on May 3 the Admiralty loses one of its most faithful servants, and the Royal Corps of Naval Constructors one of its best-known and valued officers. A summary of Mr. Apsey's career is given in *Engineering* for May 9. He entered Sheerness Dockyard in 1877, and became a student at the Royal Naval College, Greenwich, in 1882. He was inspecting officer for torpedo-boat destroyers from 1895 to 1902, and became chief constructor at Gibraltar in 1913. He also served at Rosyth and Portsmouth, and joined the Department of the Director of Dockyards in July, 1916. He was in his fifty-sixth year at the time of his death.

THE North-East Coast Institution of Engineers and Shipbuilders is to hold a summer meeting at Newcastle-on-Tyne on July 9–11. The following papers have been arranged for:—"Women's Work in Engineering and Shipbuilding during the War," the Hon. Lady Parsons; "Shipbuilding and Marine Engineering done on the North-East Coast during the War," E. L. Orde; "Aviation during the War, and its Possible Future," Lord Weir; "Dazzling of Ships," Lt.-Comdr. Wilkinson; "Limits of Thermal Efficiency in Diesel and other Internal-combustion Engines," Sir Dugald Clerk; "Ship-repairing during the War," M. C. James and L. E. Smith; "Transmission of Power," G. Constantinesco; and a lecture by Prof. J. C. McLennan.

THE Home Secretary has appointed a Committee to inquire and report on possible improvements in miners' lamps as regards safety and illumination and alterations which may be desirable in the present methods of testing and approving such lamps for the purposes of Section 33 of the Coal Mines Act, 1911. The Committee consists of Mr. W. Walker (chairman), Prof. F. Edwin Armstrong, Mr. T. G. Davies, Mr. V. Hartshorn, M.P., Mr. G. A. Mitcheson, Mr. S. Roebuck, Mr. J. Wallwork, and Dr. R. V. Wheeler, Director of the Home Office Experimental Station at Eskmeals. Mr. E. G. Fudge is the secretary, and communications on the subject should be addressed to him at the Home Office, Whitehall, S.W.1.

ARCHÆOLOGISTS will welcome the appearance in *L'Anthropologie* (vol. xxix., Nos. 1–2) of another instalment of L'Abbé H. Breuil's valuable accounts of paintings in Spanish caves. He now deals with discoveries made in 1909 in the valley of Bateucas, Salamanca. If these drawings in artistic skill fall short of those already discovered at Altamira, Marsoulas, or La Mourthe, they still possess much interest, including rude figures of human beings, animals, and fish. The question of the age of these paintings is still under discussion, but M. Breuil remarks that it seems difficult to assign the Bateucas frescoes to the Neolithic age in the apparent absence of any monument or object in the vicinity characteristic of that period.

IN the *Quarterly Review* for April Dr. R. R. Marett, taking as his text Sir James Frazer's "Folk-lore in the Old Testament," discusses the current modes of interpreting folk-beliefs, and suggests a method more in accordance with the psychology of the folk.

Hitherto folk-lore has been defined as "the study of survivals, a palæontology of human culture," whereas the new philosophy treats it, "not as so much dead matter, but as the outcome of an organic process, namely, of an existing or recently existing folk-life." Despite the vast mass of detailed evidence that lies ready to hand, there has never been attempted a comprehensive description of the mental life of the folk at our doors, much less a general analysis that makes out how and why it is so markedly gregarious in its distinctive manifestations. In other words, tradition must be treated as the live expression of the collective consciousness. And in considering the material we must make due allowance for the fact that lack of meaning may or may not imply loss of meaning. This important paper deserves the attention of all students of popular beliefs.

MR. J. H. GURNEY'S "Ornithological Notes from Norfolk for 1918," in *British Birds* for April, make good reading, for, among other things, he tells us that there is good reason to believe that as many as six pairs of bitterns bred in Norfolk during the spring and summer of 1918. At least five out of these six were reared successfully. The great crested grebe, the gadwall, the shoveller, and the bearded tit are also on the increase as the result of the jealous protection now extended over the area of the Broads district.

WE have received the report of the Director-General of Public Health, New South Wales, for the year ended December 31, 1916. It contains a mass of statistical and other matter concerning the health of the State. It is of interest that the minimal legal standard adopted for the fat in milk is 3·2 per cent., ours being only 3 per cent. As regards research work, a record has been kept of the number and seasonal prevalence of fleas on rats, and an extended investigation has been carried out on dengue fever in Australia—its transmission by certain mosquitoes, the presence of a filterable virus in the disease, and observations on immunity, length of the incubation period, and other clinical features.

THE land planarians of Ceylon have been the subject of considerable attention, but those of India have hitherto been almost entirely neglected, so that records of the latter are rare, incomplete, and uncertain. Prof. R. H. Whitehouse has published (Records Indian Museum, vol. xvi., part 1, January, 1919) a systematic account of Indian land planarians based on specimens in the Indian Museum. Of the seventeen species recorded in this paper, ten (five described as new) belong to the well-known genus Bipalium, five (four new) to Pelmatoplana, and one to each of the genera Dolichoplana and Cotyloplana.

DR. A. G. MAYOR'S report on the Department of Marine Biology of the Carnegie Institution of Washington for the year 1916, which has only recently reached us, contains a record of much work of interest to marine biologists. During a month's stay on the Island of Tobago Dr. Th. Mortensen was able to study the larval development of ten West Indian Echinoderms, the larvæ in several cases being reared through the metamorphosis. The physical conditions at Tobago are described as being unusually good for work of this character. Dr. H. Lyman Clark also describes the location of the Tobago laboratory as being an ideal one for Echinoderm studies. Mr. L. R. Cary gives an account of his studies on the physiology of the nervous system of Cassiopea, and Dr. A. J. Goldfarb describes experiments on the ageing and death of germ-cells, the eggs and sperm of the sea-urchin, *Toxopneustes variegatus*, having been used for the experiments.

Two translations lately received from Sir Robert Hadfield refer to recent developments in Germany. One of these is entitled "The Union of Technical Men," the inaugural meeting of which was held in Berlin fourteen days after the signing of the armistice. Its chief object is to ensure that technologists may bring their influence to bear on the Government, Parliament, and the economic life of the country. To attain this object an endeavour will be made to bring representatives of all branches of technical practice, from the foreman to the technical chief, into one comprehensive organisation. More than two thousand technical men attended the inaugural meeting, and papers were read by Siegfried Hartmann and Engineer Genest. The other document is a translation of an address by Herr Krupp von Bohlen on "Co-operation and Profit-sharing." In this address the lecturer dealt with a number of problems relating to the co-operation of workers in the undertaking and profit-sharing, and intimated that many changes would have to be made in the firm to keep pace with the present trend of the times with a view to continued development on sound lines.

IN a paper read before the Washington Academy of Sciences in June, which is reproduced in the Monthly Weather Review of the United States Weather Bureau for October, Prof. W. S. Franklin, of the Massachusetts Institute of Technology, directs attention to a much-needed change of emphasis in meteorological research. Hitherto it has mostly been occupied too exclusively in averaging large collections of observations, when a more detailed study of the movements of individual storms, and the determination of the correlation between storms of the same type on successive days, would be of much greater service in weather prediction. Prof. Franklin believes that such an intensive study of weather conditions would establish the conclusion that at certain critical times in the life-history of a storm the expenditure of a very moderate amount of energy would enable the subsequent movement of the storm to be controlled.

THE following books of scientific interest are announced for publication in the near future:—"The School Gardener," J. Norris (*Cassell and Co., Ltd.*); "Psycho-Analysis and its Place in Life," M. K. Bradby (*Henry Frowde and Hodder and Stoughton*); "Universitatum et Eminentium Scholarum Index Generalis: Annuaire Général des Universités (The Year-book of the Universities)," Prof. R. de Montessus de Ballore (*Paris: Gauthier-Villars et Cie*); a translation, by Teixeira de Mattos, of another volume by Fabre, to be called "The Sacred Beetle" (*Hodder and Stoughton*); "Bird Behaviour," F. Finn, and "Insect Artisans and their Work," E. Step, both in the Nature Library (*Hutchinson and Co.*); "Telephonic Transmission, Theoretical and Applied," J. G. Hill; "Currency and Credit," R. G. Hawtrey; and a new edition—the fourth—of "The Principles of Electric-wave Telegraphy and Telephony," Prof. J. A. Fleming (*Longmans and Co.*).

THE latest Catalogue (No. 178) of Messrs. W. Heffer and Sons, Ltd., Cambridge, possesses a sentimental as well as a scientific value, seeing that it contains selections from the libraries of the late Canon Merle Norman and the late Sir William H. Preece. It should be of especial interest and use to readers of NATURE, being devoted entirely to books relating to science. Some 1300 works are listed under the

following headings:—Agriculture and Husbandry, Anthropology and Ethnology, Botany, Chemistry, Geology, Mineralogy, and Palæontology, Zoology and Biology, Physiology, Anatomy, and Medicine, with the subsection of Dentistry, Mathematics and Physics, Astronomy, and Engineering. The catalogue is strong in books published in Germany, and therefore not easily procurable at the present time. An interesting item offered for sale is a collection of about eight hundred pamphlets dealing mainly with genetics and variation, formed by the late J. R. Gregory, of the University of Cambridge. Messrs. Heffer have also for disposal a complete set of the Reports of the Scientific Results of the *Challenger* Expedition, with letters by Sir C. Wyville Thomson, Sir John Murray, and Sir George S. Nares inserted.

OUR ASTRONOMICAL COLUMN.

COMING CONJUNCTIONS.—The planets Venus and Jupiter, which are now conspicuous objects in the evening sky, will be in conjunction in right ascension on May 25, Venus being 2° 7′ N. in declination. The moon, which will be new an hour after noon on May 29, will be in conjunction with Jupiter in the early morning of June 1, and with Venus in the evening of the same day, and the picture presented by the young moon and the two planets in the evenings of May 31 and June 1 may be of interest, though the conjunctions are not close. Venus will make close conjunction with Saturn on July 2, when the distance between the two objects will be only 10′. The appearance of these three planets so near together in the evening sky is noteworthy.

MARS.—A memoir on Mars from the pen of Mr. Harold Thomson, president of the British Astronomical Association, appears in *Scientia* for May. Mr. Thomson narrates concisely the facts known about the planet from observation, and takes the very proper view that it is not specially the function of the astronomer to indulge in speculations as to the possibility of inhabitants of other worlds based on such facts, but only to collect them. Nevertheless, he makes the point that the changes in the form of the dark markings and in their positions may represent changes on the surface of the planet which have analogies on our earth in the destruction of large forest areas, the ploughing up of vast tracts of land, or the changes caused by the operations of husbandry, and this may supply arguments to those who assert the existence of intelligent beings on Mars of as great weight as those furnished by the canals. The author gives no definitive opinion of his own on the question, but suggests that further observation may lead to substantial increase in our knowledge of the physical conditions of the planet.

AVIATION AND WEATHER.

ATLANTIC flying is steadily increasing in interest with the delay occasioned by the weather and by the increase in the number of competitors with the lapse of time. If any season of the year is favourable to a westerly flight it is the spring, and certainly just at present the prevailing east winds over the Atlantic near the surface of the sea would, in a measure, encourage the aspirants for a flight from the British Isles westwards. St. John's, Newfoundland, is evidently a badly chosen spot for a start on an easterly flight, if only for the reason that should a start be made the prevailing fogs would not allow of a safe return if for any reason a return is necessary. In a westerly flight from the European side certain localities must be avoided for landing, due to the well-known prevalence of fog. The shoal-water in the neighbourhood of St. John's is evidently an important factor in the formation of fog, and with easterly winds fogs seem to be much intensified. The United States naval seaplanes have accomplished their first stages as far as Newfoundland satisfactorily, but the next stage to the Azores is a more severe test. Adverse winds would materially hamper their flight, and at present it scarcely seems that contrary winds can be avoided on a part at least of the route to be chosen. American warships are stationed between Newfoundland and the Azores at such distances apart as must afford considerable confidence to those engaged in the flight. The brightness of the moon just now will be an additional advantage if winds and weather promise to be favourable.

Flight from England to Australia is now becoming as enticing to pilots of aircraft as the Atlantic flight. The *Times* of May 12 announces that "the preliminary conditions of the Australian Government's offer of a 10,000*l*. prize for the first Australian airman to fly from Great Britain to the Commonwealth have been arranged at a conference attended by representatives of Mr. Andrew Fisher, High Commissioner for Australia in London, the Royal Aero Club, and the Air Ministry." It is stipulated that the prize must be won before the close of 1920. The distance must be completed in 720 hours, and a disabled machine must not be towed more than 100 miles, and not more than twenty miles at one time. The probable route will include, amongst other places, Paris, Rome, Bagdad, Calcutta, Singapore, Batavia, and Port Darwin. There is plenty of work for meteorologists at present to decide the most favourable passage for aeronauts engaged in commercial aircraft traffic, and this second prize for a long route will require much thought and calculation. A good deal is known with regard to the winds near the earth's surface, but for a large portion of the route little has been ascertained as to the direction and velocity of the upper air.

Flying and the weather at sea by wireless reports from ships is dealt with by the Admiralty in a "Notice to Mariners" (No. 880, 1919). Arrangements are being made for the regular supply of information three times a day, at 1 a.m., 7 a.m., and 1 p.m., Greenwich mean time, when vessels are within a certain distance of stations being established in the north-eastern Atlantic. It is proposed to collect weather information by wireless from ships at sea all over the world, and it is hoped that the information received will be of use for the requirements of aircraft and admit of ships being supplied with trustworthy weather reports and forecasts wherever they may be. Much of the success of the undertaking depends on the rapidity of passing such data by wireless from the ship to the coast station and on to the Weather Office. Ships not supplying data are asked to exercise care not to interfere with the transmission of the wireless messages to the shore. At present the scheme is undertaken by the British Meteorological Office, and revision of the scheme will necessarily be made from time to time. It is proposed that ships communicating the weather information should send out a warning which is designed to notify ships within range that a report is about to be made, and that they should therefore avoid interfering. A wireless weather bulletin issued to ships may take the form of an official weather report giving the existing weather conditions, or an official weather forecast giving the probable future weather conditions. The "Notice to Mariners" will necessarily be studied by all vessels interested in the weather advance proposed.

FUEL ECONOMY.[1]

EVERY nation which joined in the war suddenly found its productive man-power reduced while the productive capacity of the country had to be increased. Questions of economy, which used to be considered from a money point of view, now appeared in their true aspect as being quantity problems. It was not easy to discard the old methods, especially at a time when attention had to be riveted on the many new subjects which arose out of the war, and the University of Illinois is to be congratulated on having drawn up a set of most useful instructions as to how fuel economy, from the quantitative point of view, can be effected without even mentioning the saving in costs. The committee which drew up the instructions had the assistance of an advisory committee, which included railway engineers and representatives of locomotive engineers and firemen, and it would almost seem as if their influence had had the salutary effect of toning down scientific truths to a level where they could be understood by firemen.

The nearest approach to what might be called science

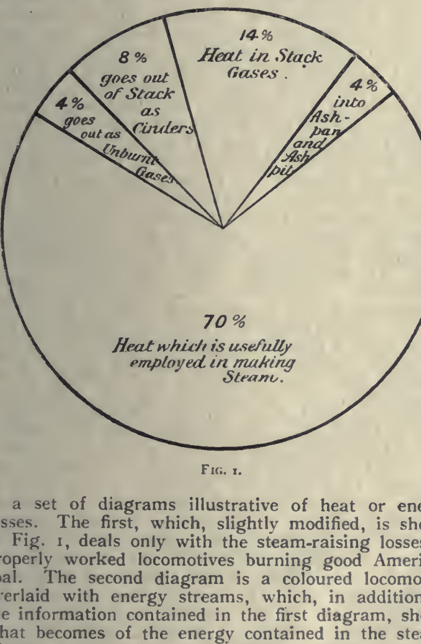

FIG. 1.

is a set of diagrams illustrative of heat or energy losses. The first, which, slightly modified, is shown in Fig. 1, deals only with the steam-raising losses in properly worked locomotives burning good American coal. The second diagram is a coloured locomotive overlaid with energy streams, which, in addition to the information contained in the first diagram, shows what becomes of the energy contained in the steam. Five per cent. is lost by radiation, 6 per cent. is used for auxiliary purposes, 52 per cent. escapes with the exhaust steam, and only 6 per cent. of energy is converted into useful work at the drawbar.

The Bulletin then proceeds to deal with these various losses and to explain how engineers and firemen can reduce them, the firing instructions being beautifully illustrated, but the committee does not stop there; it shows how coal is wasted before it reaches the locomotive both during transport and when stored, for, so it appears, American coal-dumps seem to take fire fairly frequently. Railway officials, from signalmen to repair works managers, are also told that they cause a lot of waste, for it is estimated that 20 per cent. of fuel is burnt by a locomotive while raising steam and while waiting for a job, or on the road when the signals are against it.

In view of our present shortage of coal, it would be very desirable that this Bulletin should be widely circulated in this country, not only amongst railwaymen, who are, of course, chiefly interested, but also amongst the general public, who with its help would gain some insight into the complexity of railway management. This will be all the more desirable if the State purchase of railways is to be carried out.

The paper contains some interesting statistics about American coal, from which we learn that 22 per cent. (150,000,000 tons) is consumed in locomotives for hauling purposes alone, which is a little more than one ton per head of population. Unfortunately, only 6 per cent. of these 150,000,000 tons are doing useful work. Doubtless, from a money-making point of view, this enormous loss of 94 per cent. cannot be materially reduced, but from a national point of view encouragement should be given to quantitative saving in order to prolong the time during which our coal resources may remain at our disposal.

[1] "The Economic Use of Coal in Railway Locomotives." University of Illinois Bulletin, vol. xvi., No. 2, 1918.

THE EFFICIENCY OF INVENTIONS.

A PAPER entitled "Efficient Invention," with special reference to patents affected by the war, was read before the Institution of Automobile Engineers by Mr. Douglas Leechman on February 5. The author recommends the Government to secure the confidence of the inventor by understanding, appreciating, and encouraging him. It is further suggested that (1) the present surplus of 100,000*l*. a year between the receipts and expenditure of the Patent Office should be surrendered to the inventor by way of reductions in the renewal fees payable on patents, and (2) the period of protection lost owing to the war should be added to the term of the patents affected. A proposal is also made that all patents which have expired since August 4, 1914, should be restored for a period equal to the duration of the war. Mr. Leechman states that the efficiency of inventions from the point of view of the patentee depends upon (1) the nature of the invention, (2) the capabilities of the inventor and his opportunities for working or placing the invention, (3) the way in which the invention is received, and (4) the law relating to inventions. He comments upon each of these matters, and expresses the opinion that the average inventor is lacking in the commercial instinct. A recommendation is made that some business experience should be included in the instruction given to inventors. Sound advice is also offered with regard to the steps which should be taken when inventions are being placed on the market and in connection with dealings with licensees. It may be doubted whether Mr. Leechman's proposal to restore indiscriminately all patents which expired during the war would either achieve the end desired or even prove tolerably satisfactory; its adoption would certainly prejudicially affect many persons who have legitimately embarked upon the manufacture of the articles the expired patents of which it is proposed to revive. A more equitable method of dealing with the patentees who have suffered exceptional hardship owing to the decision of the Government to concentrate the energies of the country on the production of munitions would be to ascertain the probable extent of the loss in each particular case, and to provide compensation accordingly out of a fund voted by Parliament for this purpose.

CHEMISTRY IN THE NATIONAL SERVICE.[1]

SINCE the autumn of 1914 a great change has taken place in the public attitude towards the natural sciences, and towards chemistry in particular. One of the recognised duties of the spokesmen of science during the past sixty years or more has been that of endeavouring to bring home to the general public and to its administrators the danger of neglecting the cultivation of pure and applied science. The eloquent discourses of our predecessors, Lyon Playfair, Roscoe, Meldola, and the veterans happily still with us, Tilden and Armstrong, all past-presidents of our society, on the national importance of chemistry are well known to all of us, but we cannot claim that these utterances produced an effect compatible with their gravity.

Recent events have, however, given a stimulus to the popular appreciation of the need for wider application to scientific investigation of all kinds which is incomparably greater than had been excited by the previous half-century of the spoken and written word. It may be useful at the present time to consider a few of the causes for this change in public opinion, partly because of the clarification of ideas which emerges from free discussion, partly because of the desirability of recording certain facts and particulars which may be of value to future historians of the strenuous period now ending and giving place to another still more strenuous.

At this time four years ago an urgent call was made for the services in a military capacity of all the chemists who could be spared from civil life. Large numbers were taken into the Army, and formed the nucleus of the magnificent Gas Warfare Service which has been slowly but efficiently developed. Many of these colleagues of ours are now returning to their legitimate spheres in the industrial and scientific life of the Empire, but many will not return; among those who have fallen I would refer more particularly to one who was well known to most present for the invaluable services which he rendered on the defensive side of chemical warfare. Lt.-Col. Harrison was one of the great discoveries of the war, and his death on the eve of the armistice was one of its many great tragedies; the protection against gas-poisoning which has been employed by our own and Allied troops, a protection far more efficient than that ensured by the devices elaborated at leisure by the Central Powers, was due mainly to his wide knowledge, great organising ability, and unfailing resourcefulness in emergency. A movement for the establishment of a memorial to Col. Harrison was set on foot by the Chemical Warfare Committee, of which he was the Controller at the time of his death, and a considerable sum has been collected from those who had been associated with him in his work for the Services. The Chemical Warfare Committee has approached the council of the Chemical Society, and has offered, under certain conditions, to place a memorial tablet or other suitable permanent memorial in these rooms, and also, under certain further conditions, to establish a trust fund to be held by the society. The council has with great pleasure intimated its willingness to accept these gifts, and one of the first duties of your new council will be to decide how best to carry out the provisions of the trust deed.

The efficiency of the British gas protection, which called for the exhibition of so much scientific skill both in research and in manufacture, and led to its adoption by our Allies, is one striking illustration of the paramount importance of science which has appealed to the general public. This subject is, however, but a small branch of the enormous chemical problem which presented itself to the nation nearly five years ago, and led to the organisation under Lord Moulton of the Department of Explosives Supplies. During the working out of this problem issues presented themselves which are probably dissimilar from any which have ever arisen before.

Thus, as the magnitude of the struggle became gradually obvious, it was realised that the whole of the resources of the Empire would have to be utilised fully if success was to be attained. A census of all available chemical products had to be taken and schemes for their exploitation laid down; all materials had to be apportioned out in accordance with the principle that whatever was used for the manufacture of one particular war material left a corresponding shortage of raw material in connection with the manufacture of some other, and perhaps equally essential, product. The intricacy of gauging the chlorine output of the country, of determining how to increase it at the maximum rate without unduly disturbing other interests, of apportioning it most advantageously for use as liquid chlorine and for the manufacture of phosgene, sulphur chloride, carbon tetrachloride, bleaching powder, and many other war materials, is such as would disarm criticism even if the result had been failure instead of brilliant success. This novel mode of presentment, involving recognition of the principle that the Empire could only dispose of certain limited and measurable quantities of raw materials, was but one of the many fresh views which forced themselves upon a newly created Ministerial Department. Labour, fuel, and transport had to be discussed in an analogous manner.

The cessation of hostilities found this country manufacturing, roughly, 100,000 tons per annum each of nitric acid and sulphur trioxide with an efficiency of about 93 and 91 per cent. respectively of that theoretically obtainable; we were also making 60,000 tons of T.N.T. and 35,000 tons of cordite per annum. These productions were for all practical purposes upon a permanent basis, and could have been continued indefinitely. The factories necessary for securing this huge production were erected by the Government, and for several reasons. First, for economy in production. In spite of the large initial cost of installation, and including rapid amortisation, the national production of cordite was better in quality than, and of approximately one-half the cost of, that imported from America. Secondly, for certainty of supply, which could be ensured only by a home production not subject to the risks of oversea transport.

With this necessity for gigantic production the urgency for economy in manufacture necessarily went hand in hand. One of the most interesting documents of the war is the second report on costs and efficiencies for H.M. factories controlled by the Department of Explosives Supplies, which has been recently issued. This report contains a minute analysis of the working costs for each period of each factory engaged upon individual items of manufacture; it states what proportion of the cost per ton of product is borne by labour, raw materials, fuel, maintenance, etc., and provides an incitement to further effort towards economy of working by giving a "bogey" cost-sheet made up of the most efficient details of cost selected from the complete analysis of expenses. It will be clear that an immense amount of organising power was required to achieve this stupendous result; it was due largely to the genius and energy of Mr. K. B. Quinan.

It must be remembered, however, that this permanent memorial to British chemical activity in production was rendered possible only by the intense

[1] Presidential address delivered to the Chemical Society on March 27 by Sir William J. Pope, K.B.E., F.R.S.

effort of the army of chemists and engineers enlisted under the command of Lord Moulton. The necessity for utilising all the chemical resources of the country to the utmost led, in direct relationship with the census of raw materials previously mentioned, to the attempt to extract the last possible fraction of efficiency in each component process. The huge production just indicated made it very profitable to carry out a vast amount of careful scientific investigation of details of manufacture; so many fellows of this society devoted their best efforts to this work that it would be invidious to mention names. Our colleagues have had ample opportunity to realise that the romance of war is now to be found in the laboratory, the workshop, and the factory quite as much as on the battlefield.

An instructive example of the operations of the struggle for economy in the production of a given effect is found in the rivalry which arose between picric acid and ammonium nitrate for use as high explosives. Picric acid costs about 185*l.* per ton to make, ammonium nitrate about 50*l.*, and T.N.T. about 100*l.* per ton; the high cost of picric acid means, of course, limited production. A mixture of eighty parts of ammonium nitrate with twenty parts of T.N.T., known as amatol, was introduced early by the Research Department at Woolwich as being about 5 per cent. more powerful as a high explosive, less *brisant*, and more difficult to detonate, and, of course, far less costly to manufacture. The course of the war has been marked by continued progress at the hands of our research chemists in the preparation and application of amatol; the growing appreciation of the merits of this material led to the discontinuance of the manufacture of picric acid in this country last summer, to the adoption of amatol in place of picric acid as the American standard high explosive, to the approaching elimination of picric acid from the Italian military programme, and to the replacement, in the main, of picric acid by amatol in the French service.

A very pertinent question arises in connection with the fact that our production of the chemical materials needed for a great European war was negligibly small in 1914 and has gradually attained satisfactory dimensions. We know that the great chemical factories of Central Europe could divert their peace production of chemical products to a war output at very short notice. None of these huge installations requires much time for the design and construction of chemical plant for new purposes; all possess a series of standard items of equipment which can be fitted together rapidly to form a piece of plant capable of use for throwing any ordinary laboratory operation into large-scale practice. Stills, condensers, pressure vessels, filter presses, cooling arrangements of coils, and the like, are available in standard sizes and with standard fittings in such a manner that the installation on a works scale of a laboratory operation is deprived of its most formidable difficulties. The question which demands an answer is why, when the German works were in existence and could attain a war production so quickly, were the Allied nations given time gradually to develop their war production of explosives, noxious materials, etc., from nothing? The question is best answered by an example.

In July, 1917, the Germans first used against the Allies a new offensive material, $\beta\beta$-dichloroethyl sulphide, $(CH_2Cl.CH_2)_2S$, and with very great success. This substance, the so-called "mustard gas," has but little odour, and exposure to it causes comparatively few fatalities; inhalation of, or contact with, its vapour gives rise to acute pneumonia when inhaled, to the production of painful sores, and to temporary, or even permanent, blindness. Whilst, as has been stated, the actual mortality is low, and the use of the substance may to this extent be described as humane, the casualties produced are very numerous; slight exposure to a material so toxic and so difficult to detect leads, in general, to six weeks in hospital. The preparation of $\beta\beta$-dichloroethyl sulphide was described by Victor Meyer in 1886, and involved the several operations indicated by the following set of equations:—

(1) $CH_2 : CH_2 + HClO = CH_2Cl.CH_2OH.$
(2) $2CH_2Cl.CH_2.OH + Na_2S = (HO.CH_2.CH_2)_2S + 2NaCl.$
(3) $(HO.CH_2.CH_2)_2S + 2HCl = (CH_2Cl.CH_2)_2S. + 2H_2O.$

When it is realised that operation No. 1 is difficult, and that the products of reactions (1) and (2) are soluble in water, it will be understood that no small difficulties must present themselves in the manufacture of $\beta\beta$-dichloroethyl sulphide by this process on a large scale. The examination of the German product made it quite clear, however, that the process of manufacture adopted was that indicated by the above set of equations; the over-all yield of product is perhaps 40 to 60 per cent. of the theory. In view of the difficulties of manufacture, it was fairly certain that no chemical installation for its production could be established under the control of the Allies within any reasonable time; the Central nations thus supposed that they held the monopoly of a very powerful instrument of war.

Most British organic chemists were, I think, amazed at the method of production adopted by the German manufacturers; to apply such a technically cumbrous process for the manufacture of so simple a compound seemed quite irrational. By the end of January, 1918, a process for making $\beta\beta$-dichloroethyl sulphide had been worked out in the British laboratories which consisted of the reaction expressed by the following equation:—

$$2CH_2 : CH_2 + S_2Cl_2 = (CH_2Cl.CH_2)_2S + S.$$

The yield obtained in the laboratory was 98 to 99 per cent. of that theoretically possible. The new method was communicated to France and America, and installed by the three great Allies on a large scale; at the conclusion of the armistice the available daily production of mustard gas by the Allies was equal to the monthly production of the Central nations.

The answer to the question just put is now available. The German Chemical Service was inefficient; the scientific chemists under its control were incompetent.

The Allied production of mustard gas had a potentiality of the order of thirty times as great as that of the German; the cost of the German material was of the order of thirty times as great as that of our product. Cost of production under the conditions prevailing for this particular material means, in the end, expenditure in labour; that we were able to produce at something of the order of one-thirtieth of the cost of the German production means that by the allocation of the same quantity of raw materials we could secure thirty times the output. The relative strain on the productive resources of the Allies and the Central nations caused by the demand for a certain quantity of mustard gas is measured, roughly, by the ratio of one to thirty.

Whilst many instances similar to that of mustard gas might be quoted to show that Germany has been badly served by her scientific men during the war, it would be difficult to overrate the effects of the skill and perseverance exhibited by the German chemical manufacturer. The command of great and long-established factories for fine chemical manufacture enabled the German technologist to throw faulty academic projects rapidly into large-scale production. The cost—namely, the strain on national resources—

was enormous, but that an output could have been achieved is a significant tribute to the potentialities represented by the large German fine chemical factories. Both in Britain and in Germany production in chemical manufacture has been multiplied during the war, but necessarily in a different manner. Our large production is almost entirely of war importance, and most of the works installed during the war must now be dismantled as a result of the cessation of hostilities; the German expansions, on the other hand, constitute a permanent addition to the potentialities of peace manufacture of staple marketable products. The war has left Germany with vastly increased resources as a manufacturer of much-needed chemical products.

The view that our country is superior to Germany in the possession of creative scientific power has always been maintained in modern times by students of philosophy and history; the correctness of the view has been amply demonstrated during the last four years. Whilst our nation has overcome its initial handicap by a continuous flow of novel scientific devices of military value, our enemies passed through the war with little more in the shape of novel effects than those laboriously elaborated during the preceding years of peace. The more brilliant position which Germany has so long held in applied science arose from the keen appreciation exhibited by German public and official authorities of the rich economic fruits to be reaped from the systematic exploitation of scientific industry as compared with the neglect of scientific effort shown by corresponding classes in this country. Even yet but small encouragement exists for those who desire to see pure and applied science flourish as it deserves in Great Britain. Although it may be long before the scientific industries of Central Europe regain their former predominance, there seems but little prospect of sufficient official encouragement being given in this country to scientific and industrial initiative to ensure our position in the competition with other nations.

In this connection it is interesting to notice what is happening in the United States. Immediately after her entry into the war America initiated a census of chemists, and in July, 1917, a fully detailed description was available of some 15,000 chemists resident in the States; a research staff consisting of 1200 technical men, with appropriate assistance, was enlisted for the Research Division of the Chemical Warfare Service alone. Since America was only in the war for about eighteen months, this powerful organisation had not time to make its efforts properly felt. Apart from small improvements or changes in detail, practically all the American chemical equipment, for both offence and defence, was manufactured on the detailed plans furnished by Great Britain or France; the available time was too short to allow full play to American genius for novelty and for magnitude of production. The necessity for co-operation brought large numbers of young and active American chemical officers to Europe; it gave those officers for eighteen months the entry to practically every chemical works of importance in England and France, and unrivalled opportunities for accurately judging European chemical methods and markets. Those men have now returned to their ordinary scientific and technical pursuits in the States, and it cannot be expected that they have left behind them the unique experience which they have gained of European conditions.

We may anticipate that competition in pure and applied chemistry between Europe and America will become increasingly keener during the years to come. The competition is already intense, and gives little promise as yet of turning in our favour; it is, in fact, difficult to see how many of the staple products of fine chemical manufacture can hold their own in Great Britain against American competition under the conditions which arose during the first three years of the war. During these years peace production flourished in the States free from Government control, whilst in this country the establishment of a fine chemical industry in war-time was naturally rendered far more difficult by State control of works, materials, and labour.

The bearing of this may be made clearer by an instance. The manufacture of saccharin was installed in England after the outbreak of war, but the production was controlled in that the manufacturers were only permitted to sell at a profit of 10 per cent. on the cost, this profit being, in turn, subject to the excess profits tax; further, to prevent the economic difficulties which were foreseen if saccharin competed with sugar, the price of English-made saccharin was fixed at a figure which involved the very large addition of 30*s*. per lb. to the price, this addition being appropriated by the Government. Simultaneously, saccharin was manufactured free of all control in the States; it came into this country unrestricted and on such terms that the American producer took the 30*s*. per lb. just mentioned in addition to the considerable profit previously made by reason of lower cost of manufacture. America, having thus been assisted by our Government to build up a large reserve of profits, is now actually selling saccharin in England at 11*s*. per lb.—a price at which it cannot be produced here—apparently with the legitimate trade purpose of destroying the English manufacture and afterwards running up the price.

Many cases may be quoted as closely analogous to that of saccharin, notably in connection with acetic acid, glycerol, acetone, and methyl alcohol and their products, in which British procedure has facilitated profiteering in foreign countries during the war. The excess profits tax operated insidiously in tempting British manufacturers to keep prices high so as to retain a margin with which to write off capital expenditure in spite of the tax; the foreign competitor, free from Government control of raw materials and exempt from the excess profits tax, was able to take full advantage of the ruling high rates. It will be of interest to see how the problems introduced by these actual occurrences are to be solved advantageously for Great Britain in the great reconstruction upon which our administrators are now engaged.

Sufficient has probably now been said in justification of the rapid appreciation of science, and especially of that branch of science with which we are particularly concerned, in the public and administrative eye. The sudden incidence of new scientific modes of military and naval attack, and the quick improvisation and development of equally scientific means of reply, both of which have been so frequently exhibited during the past five years, must have seemed uncanny to the lay observer, who only realised the effects, but did not understand the causes.

At the present time, however, most fellows of this society have little leisure to reflect upon the ghastly tragedy in which it has been our privilege to assist; the curtain has fallen upon this, but is rising again upon the greatest epoch in the history of the world. The coming struggle for scientific and industrial position, upon the results of which must rest the whole intellectual, artistic, and material future of our race, will call for longer, greater, more persistent, and more intelligent effort than any which we have hitherto exerted. We are forced to consider whether we have reason to hope that the recent lessons have been well brought home, and whether the free play given to scientific creation and production during the last five years is to persist unhampered in the future. For

purposes of war our administrators gave every incentive to scientific investigation; money, men, and material were provided for the asking, free from Treasury control—free, in fact, from all control other than that of the scientific worker able and willing to organise and execute a necessary piece of work.

I see no reason to think that the lesson has been properly learnt, and every reason to anticipate a re-establishment of that parsimonious treatment of scientific effort which seems now to belong to a past age, but with which we were all well acquainted five years ago. The control of scientific research is again leaving the hands of the scientific man and being resumed by the lay administrator. The old remark has been resuscitated quite recently that "it is a commonplace among administrators to fear the expert." The non-technical administrator has no means of distinguishing the expert from the charlatan; he has, perforce, to regard the scientific expert as the lineal descendant of the "adept" of alchemical times, whose main claim to recollection is based upon the adroitness with which he was able to divert public funds to his own base purposes.

It is quite clear that if scientific research is to be assisted by the State—and unless so aided it will languish, and carry with it into decadence every activity of the Empire—it must be administered by men of scientific training and eminence; any other mode of procedure will necessarily lead to the strangulation of scientific effort by departmental red tape. In this connection it is again instructive to refer to American practice. Our blood-relatives across the Atlantic had three years in which to study in peace the efforts which we were making in war, and it cannot but be useful to observe the manner in which they propose to profit by our experience.

In 1916 President Wilson, a university professor and an expert, now one of the most imposing figures in terrestrial affairs, called upon the National Academy of Sciences at Washington to nominate the members of a "National Research Council"; the object of this new organisation was stated to be that of co-ordinating the scientific work of the country in order that the scientific problems both of war and of peace might be more efficiently solved. The National Research Council is under the presidency of one of the most eminent among the active American men of science, Prof. George E. Hale, of the Mount Wilson Observatory, and has large funds at its command for research purposes. Two points are conspicuous in connection with the American programme—first, the substitution of the professional lay administrator by the ordinary office staff; secondly, the recognition of the close interdependence of pure and applied science. The contention which has long been advanced in this country, that an adequate output of purely academic chemical research work and the existence of a flourishing fine chemical industry are mutually essential, is here tacitly accepted; the former seeks in the industries remunerative positions for the products of its training, and the fine chemical industry looks to the scientific investigator for inspiration and new directions for enterprise. The nation which possesses an extensive organic chemical industry controls chemical warfare, the production of pharmaceutical and photographic products, the textile industry, and many other great departments of human activity.

The operations of the great American organisation for the stimulation of scientific research work are already making themselves felt. They have produced just recently an entirely novel method for oxidising naphthalene to phthalic acid, presumably by the use of atmospheric oxygen and a catalyst, which gives a 95 per cent. yield, and are responsible for the huge nitrogen fixation scheme now under installation in the States. These two illustrations alone, the one small and the other large, leave us in no doubt as to the influence which the National Research Council is destined to exert on scientific and technical progress throughout the world.

If British science is to make itself adequately felt in the great intellectual and material advances of the near future, British men of science must be entrusted with the initiative power and the command of money which they have enjoyed during the past few years; unless this is done our Empire will, as before, continue to fall behind other great nations as a contributor to the increasing mass of pure and applied scientific knowledge.

In an address which I had the honour of delivering in this room a year ago attention was directed to the necessity for closer co-operation between the large societies representing the various chemical interests in Great Britain. During the past year action has been taken in this matter, and some fifteen of the societies have now collaborated in the establishment of a Federal Council for Pure and Applied Chemistry, the function of which is to advance, safeguard, and voice the interests of chemical science. The Federal Council consists of representatives nominated by the component bodies, and is already occupying itself actively with the questions within its purview; it has moved with some success in connection with the claims of experimental science to recognition in the recently established scheme for education within the Army, with the provision of fine chemicals for research purposes, with the remuneration of scientific posts, and with other matters. The Federal Council will continue to apply itself to those questions which are of importance to chemists as a class, leaving more specific chemical interests to be dealt with by the appropriate constituent societies. A very similar project for the consolidation of the larger chemical interests is in course of execution by our French colleagues.

It is beyond question that a central house for accommodating the chemical societies in a manner more proportionate to their importance than is at present possible should be provided; that a common chemical library far more complete than any now available in this country should be at our service: and that some comprehensive scheme for the publication of compendia of chemical knowledge should be put into operation. A very imposing and costly programme confronts the recent amalgamation of chemical interests, but the universal approval which greeted the proposition for creating a Federal Council for Pure and Applied Chemistry is a happy augury for the future usefulness of the new organisation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At a meeting in Birmingham on May 8 of representatives of the engineering profession and others, the Lord Mayor presiding, a provisional scheme for celebrating the centenary of the death of James Watt was agreed upon. We are glad to note that the scheme includes the endowment of a chair of engineering at the University. A point which is sometimes overlooked in such matters was made by Sir Oliver Lodge, who reminded the meeting that endowments of this kind, though most desirable, should not be regarded as gifts conferring benefit only on the University. The University acted as a trustee, and every new chair endowed involved expense. Apparently no definite opinion was expressed as to the salary which should be attached to the chair; this would no doubt depend upon the sum collected for the memorial.

Taking into consideration, however, the vast benefits accruing to the world from the genius of James Watt, we may hope that the endowment will be a liberal one, so that the full services of the best possible men may be secured. If a considerable sum could also be allotted as an endowment for the department over which the professor would preside, and a further amount to provide valuable research scholarships for promising students from any part of the Empire, a memorial worthy of the subject might be established. For example, the appointment of a professor, for ten years at a time, with a salary of 5000*l.* per annum, with a like sum towards the upkeep of the department, and, in addition, the provision of ten scholarships each of 500*l.* per annum tenable for two years, might cost 300,000*l.*, but the money would be profitably invested.

The evacuation of the University buildings by the military hospital authorities is proceeding rapidly, and it is hoped that the departments of physics and chemistry at least may be reinstated in their proper quarters by October next. The appointments of the new professors of physics and chemistry (Prof. S. W. J. Smith and Prof. G. T. Morgan) have accordingly been made as from July 1 in order that they may supervise the restoration of their respective departments.

CAMBRIDGE.—A gift of 210,000*l.* to the University for a chemical school was announced by the Vice-Chancellor, Dr. A. E. Shipley, at the meeting of the Senate on May 13. Particulars were given in the following extracts from a letter from Mr. R. Waley Cohen:—"It has been an immense pleasure to me to be able to write to Sir William Pope and tell him that the British oil companies have agreed to join together in a scheme for endowing a chemical school at Cambridge. The Burma Oil Co. have agreed to contribute 50,000*l.*; the Anglo-Persian Oil Co., 50,000*l.*; the Anglo-Saxon Petroleum Co., 50,000*l.*; and Lord Cowdray and the Hon. Clive Pearson between them 50,000*l.*, making the total of 200,000*l.* which is required. Mr. Deterding, who has taken very great interest in the scheme from the beginning, has offered to make the 200,000*l.* into guineas by adding a personal contribution of his own of 10,000*l.*"

LONDON.—The annual report of the Vice-Chancellor of the University (Sir Cooper Perry), which was read at the presentation day ceremony in the Albert Hall on May 9, was naturally written in a more cheerful strain than previous reports during the war. *Cedant arma togae*—at last the University is able to turn from the works of war, to which the Vice-Chancellor was able to refer with just pride, both in the fields of battle and of science applied to warfare, to a conflict in which "the weapons are no longer 'reeking tube and iron shard,' but the highest qualities of insight and spiritual temper." The list of gifts and benefactions during the past year indicates the wide appeal of the University, including generous provision for the teaching of aviation, modern Greek, Portuguese (in all of which new chairs have been established), and a German field-gun given by the War Office in recognition of the work of the Officers Training Corps during the war. Progress has been made with the scheme for degrees in commerce, and an institute of phonetics is to be established at University College.

OXFORD.—At a prolonged sitting of Congregation, held on May 6, various amendments to the statute which aims, amongst other objects, at making Greek optional instead of compulsory in Responsions were taken into consideration. Most of the amendments would have had the effect of limiting somewhat the choice of subjects, but all were rejected except one, which makes it possible to omit all the subjects of "Group II." (English, French, and German), and another concerning the fee for entrance to the examination. The statute as amended will have to come before a further meeting of Congregation, and if passed by that body, to be submitted to Convocation, where the final decision will be taken.

MR. G. R. BENNETT has been appointed principal of the Technical Institute, Newport, Mon.

MR. ANDREW W. YOUNG has been appointed to the post of lecturer on pure and applied mathematics at the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3.

PROF. C. R. MARSHALL, professor of materia medica and therapeutics, University of St. Andrews, has been appointed to the Regius chair of materia medica in the University of Aberdeen, vacant by the resignation of Prof. Theodore Cash.

APPLICATIONS are invited for the following awards in connection with the Armstrong College, Newcastle-upon-Tyne:—The Earl Grey memorial fellowship, value 300*l.*; the Royal (1851) Exhibition scholarship, value 200*l.*; and industrial bursaries, each of the value of 150*l.* The names of candidates must reach the secretary of the college by, at latest, May 31.

THE Higher Education Sub-Committee of the London County Council has had under consideration the report of the Government Committee appointed to inquire into the position of natural science in the educational system of Great Britain. In view of the importance of the subject, and of the value of the report, it is desirable that the conclusions and recommendations should receive the fullest consideration and discussion among those concerned in the teaching of natural science. The sub-committee has therefore arranged a meeting at County Hall, Spring Gardens, at four o'clock on Friday afternoon, May 30, to which the principals of the schools of the University, headmasters and headmistresses of secondary and central schools, principals of polytechnics and technical institutes, and science teachers of these colleges and schools have been invited. Sir J. J. Thomson, chairman of the Government Committee, has consented to address the meeting, and Sir Cyril Cobb, chairman of the Education Committee of the London County Council, will take the chair.

ANNOUNCEMENT is made in the *Times* that the Government proposes (if Parliament agrees) to expend during the next five years about 2,000,000*l.* on agricultural research and agricultural education. Substantial scholarships will be offered to men who have distinguished themselves in the natural sciences at the universities, and a certain number will be selected for employment in universities and other institutions. Research is already carried on at Cambridge, Rothamsted, Bristol, and Reading; but whereas at present there are probably not more than forty men in England and Wales engaged on pure research in agricultural science, it is hoped that during the next decade or so the number may be raised to about 150. Another feature will be the encouragement of higher agricultural education in colleges by means of grants and in other ways. There are about a dozen agricultural colleges in England and Wales, and it is hoped to bring the farmer into more sympathetic touch with them by the creation of more demonstration farms and of a keener sense of the general value of science in agriculture.

SOCIETIES AND ACADEMIES.

London.

Royal Microscopical Society, April 16.—Mr. J. E. Barnard, president, in the chair.—J. **Strachan**: The chemistry of dendritic growths in paper. The formation of these interesting and curious growths was formerly attributed to the oxidation of a particle of bronze or brass included in the sheet of paper during manufacture. Later investigations have proved, however, that the chemical reactions producing these growths are more complex. The particle of bronze is attacked by chemical residues in the paper, chief among which is sulphate of aluminium, with the formation of soluble sulphate of copper. The latter creeps along the fibres in solution. The sulphate of copper is then reduced to insoluble black sulphide of copper, which constitutes the majority of recent dendrites in paper. This sulphide is further oxidised again to sulphate, and so by alternate oxidation and reduction insoluble copper compounds may be deposited along the fibres. The final action in old dendrites is oxidation, resulting in the formation of basic copper sulphate. The chemistry of these growths is important in that they indicate, by secondary reactions, the nature of chemical actions taking place in the deterioration of paper during ageing, in which the cellulose is attacked by chemical residues from various sources. A new micro-chemical test for the detection of copper sulphide consists in the application to the dendrite of a solution containing the double cyanide of potassium and cadmium. The black copper sulphide dissolves, but is exactly replaced by a brilliant yellow pseudomorph of cadmium sulphide, forming a yellow dendrite. The principle of this mode of testing by replacement appears to be capable of further applications in micro-chemical manipulation.—Dr. E. **Penard**: *Folliculina boltoni*, S. Kent. In spite of recent statements to the contrary, the genus Folliculina is undoubtedly represented in fresh-water, and the vermiform bodies (described as *Lagynus ocellatus* by Daday) represent, as already suspected by several authors, though contradicted by others, a free-swimming form produced by a metamorphosis of the whole individual.

Zoological Society, April 29.—Prof. E. W. MacBride, vice-president, in the chair.—Dr. W. T. **Calman**: Marine boring animals. Attention was directed to the economic importance of the scientific investigation of these forms of marine animals in relation to the serious damage caused by them to the timbers of wooden ships and to piers, and to the masonry of breakwaters and similar constructions.—G. **Jennison**: A chimpanzee in the open air in England. Attention was directed to the fact that the animal had lived in a healthy and vigorous condition for a period of some eight years in the private grounds of its owner, Dr. John K. Butter, of Cannock, Staffordshire.

Linnean Society, May 1.—Sir David Prain, president, in the chair.—J. **Smith**: Forms assumed by the pappus in Compositæ. As all the facts adduced in support of the phyllome theory can be explained by assuming that the pappus in certain cases is partly a development of the hairs which were inserted on the now aborted but once free calyx-segments, the evidence in favour of the trichome or emergence nature of the organ admits of no other conclusion than that which takes the pappus to be hairs, free or fixed, derived in their evolution from the hairs of the achene, or sometimes also from the hairs of the now aborted calyx-limb.—J. M. F. **Drummond**: The flora of a small area in Palestine. The author gave the route covered by the 52nd Division (of which he was a member) between El Arish and the neighbourhood of Jaffa. Collections were made at various points along this route, and the area of Arsuf, fifteen miles north of Jaffa, was specially described, with the topography and climate. The edaphic plant-formations were dealt with, especially two—the "Calcareous Knoll" flora and the "Cistus Moor"; the former is of the nature of garigue, and contains many geophytes and annuals, with many minor xerophilous characters, but few extreme types, with only one switch-plant and no succulents. Cistus Moor has a closed carpet of vegetation, few geophytes or annuals. Cistineæ and a tussock-grass predominate; possibly akin to the Cistus-maqui of Spain. Garigue and Steppe prevail in western Palestine; Maqui was not seen at all by the author. Possibly this state of affairs is partly due to man's interference.

Dublin.

Royal Irish Academy, April 28.—Dr. R. F. Scharff, vice-president, in the chair.—N. **Colgan**: The occurrence of tropical drift seeds on the Irish Atlantic coasts. Seeds or fruits of no fewer than eight tropical species have been found, cast up from time to time, on the Irish coasts. All the species are native or naturalised in the West Indies, and all have highly buoyant seeds, capable, as Dr. Guppy has shown, of floating for twelve months and upwards. The Irish stations for these drift seeds range from Donegal to Kerry, and the records of their occurrence are spread over a couple of centuries. It has been suggested that the passage of these ocean waifs is effected by human agency. The author decides in favour of the idea that the tropical drift seeds cast up on the Irish Atlantic beaches are wafted thither from their West Indian home by natural agencies. An account of the seeds and of the plants which produce them is given.—D. P. **Montagu**: A study in regeneration in wheat (*Triticum vulgare*). A number of simultaneous sowings of wheat were made, and shoots were amputated at various stages in their development. The various theories of regeneration were reviewed in the light of the facts disclosed in Triticum, and two hypotheses were put forward, viz. (1) the regeneration observed may be traced to the disturbance in the normal absorption-transpiration-equilibrium, following the removal of the shoots by amputation, and (2) the regeneration observed may be regarded as due to the disturbance, consequent on the injury involved in the amputation, of the normal enzyme-balance. Such a disturbance leads to hydrolysis of glucoside within the plant, the cyclic element functioning as the direct causal activator of the regenerating growths, while the carbohydrate split-product is utilised to build up the regenerating tissue.

BOOKS RECEIVED.

Outlines of Theoretical Chemistry. By Dr. F. H. Getman. Second edition. Pp. xiii+539. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s*. 6*d*. net.

Applied Optics. The Computation of Optical Systems, being the "Handbuch der Angewandten Optik" of Dr. A. Steinheil and Dr. E. Voit, translated and edited by J. W. French. Vol. ii. Pp. vi+207+plates v. (London: Blackie and Son, Ltd.) 12*s*. 6*d*. net

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. iii. Pp. 495. (London: Society of Chemical Industry.) 10*s*. 6*d*.

How and What to Read. Suggestions towards a Home Library. By R. B. Buckley. Pp. 176. (London: Williams and Norgate.) 2*s*. 6*d*. net.

Meteorologia Aeronautica. By Prof. G. Crestani. Pp. xv+315. (Milano: U. Hoepli.) 8.50 lire.

Dizionario Internazionale di Aeronavigazione e Costruzioni Aeronautiche. Italiano, Francese, Inglese, Tedesco. By M. Dander. Pp. vii+227. (Milano: U. Hoepli.) 6.50 lire.

A Practical Handbook of British Birds. Edited by H. F. Witherby. Part ii. Pp. 65–128+3 plates. (London: Witherby and Co.) 4*s.* net.

The Theory of Heat. By Prof. T. Preston. Third edition. Edited by Prof. J. R. Cotter. Pp. xix+840. (London: Macmillan and Co., Ltd.) 25*s.* net.

Text-book of Embryology. Vol. ii., Vertebrata with the exception of Mammalia. By Prof. J. Graham Kerr. Pp. xii+591. (London: Macmillan and Co., Ltd.) 31*s.* 6*d.* net.

Manual of Tree Diseases. By Dr. W. H. Rankin. Pp. xx+398. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 12*s.* 6*d.* net.

Our National Forests. A Short Popular Account of the Work of the U.S. Forest Service on the National Forests. By Dr. R. H. D. Boerker. Pp. lxix+238. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 12*s.* 6*d.* net.

The Mycetozoa: A Short History of their Study in Britain. By G. Lister. Pp. 54. (Essex Field Club Special Memoirs, vol. vi.) (Stratford: Essex Field Club; London: Simpkin, Marshall, and Co., Ltd.) 3*s.* net.

Boiler Chemistry and Feed-water Supplies. By J. H. Paul. Pp. ix+242. (London: Longmans and Co.) 14*s.* net.

Text-book of Physical Chemistry. By Prof. A. T. Lincoln. Pp. viii+547. (London: G. G. Harrap and Co., Ltd.) 12*s.* 6*d.* net.

A Text-book of Physiology. By Drs. M. Flack and L. Hill. Pp. viii+800. (London: E. Arnold.) 25*s.* net.

Les Applications de la Physique Pendant la Guerre. By H. Vigneron. Pp. viii+322. (Paris: Masson et Cie.) 7 francs net.

Cotton Spinning. By W. Scott Taggart. Vol. i., Including all Processes up to the End of Carding. Sixth edition. Pp. liii+322. (London: Macmillan and Co., Ltd.) 7*s.* 6*d.* net.

The Newer Knowledge of Nutrition: The Use of Food for the Preservation of Vitality and Health. By E. V. McCollum. Pp. ix+199. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, MAY 15.

ROYAL INSTITUTION, at 3.—Prof. F. Keeble: Intensive Cultivation.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—Prof. W. H. Young: (1) The Area of Surfaces; (2) Change of the Independent Variables in a Multiple Integral.—Prof. W. A. Bone and R. J. Sarjant: Researches on the Chemistry of Coal. I. The Action of Pyridine upon the Coal Substance.—Prof. E. F. Burton: A New Method of Weighing Colloidal Particles.—W. E. Curtis: The Value of the Rydberg Constant for Spectral Series.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. H. E. Armstrong: Soil Deficiencies in India, with Special Reference to Indigo.

MATHEMATICAL SOCIETY, at 5.—G. N. Watson: Zeros of Lommel's Polynomials.—W. H. Young: The Triangulation Method of Defining the Area of a Surface.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—E. A. Laidlaw and W. H. Grinsted: The Telephone Service of Large Cities, with Special Reference to London.

CHEMICAL SOCIETY, at 8.—B. Blount and J. H. Sequeira: "Blue John" and other Forms of Fluorides.—G. M. Bennett: The Nitration of Diphenylethylenediamine.—D. L. Hammick: The Destruction of Picric Acid in Nitrating Acid.—J. C. Irvine and J. S. Dick: The Constitution of Maltose. A New Example of Degradation in the Sugar Group.—R. J. Manning and M. Nierenstein: The Tannin of the Canadian Hemlock (*Tsuga Canadensis*, Carr).

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 5.30.—Dr. S. F. Harmer: Sub-Antarctic Whales and Whaling.

MONDAY, MAY 19.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Capt. W. B. R. King: The Uses of Geology in War.

INSTITUTE OF METALS, at 8.—Ninth Annual May Lecture—Prof. F. Soddy: Radio-activity.

TUESDAY, MAY 20.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: British Ethnology—The People of Ireland.

BRITISH ASSOCIATION GEOPHYSICAL DISCUSSIONS (Royal Astronomical Society, Burlington House), at 5.—Col. H. G. Lyons will open a discussion on The Functions of a Geodetic Institute. Followed by Sir J. Larmor, Sir C. F. Close, Mr. A. R. Hinks, and others.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—Dr. F. Mollwo Perkin and T. C. Palmer: The Chemist and Engineer in Relation to the Petroleum Industry.

WEDNESDAY, MAY 21.

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Francis T. Piggott: The Principles o fJapanese Design.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Capt. C. J. P. Cave and J. S. Dines: Further Measurements on the Rate of Ascent of Pilot Balloons.—J. E. Clark and H. B. Adames: Report on the Phenological Observations for 1918.

GEOLOGICAL SOCIETY, at 5.30.

THURSDAY, MAY 22.

ROYAL INSTITUTION, at 3.—Prof. F. Keeble: Intensive Cultivation.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Prof. W. J. Sollas: The Structure of Lysorophus as Exposed by Serial Sections.—O. Rosenheim: A Preliminary Study of the Energy Expenditure and Food Requirements of Women Workers.—M. Greenwood, C. Hodson, and A. E. Tebb: Report on the Metabolism of Female Munition Workers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. S. Chapman: Electrical Phenomena occurring in High Atmospheric Levels.

SATURDAY, MAY 24.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

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THURSDAY, MAY 22, 1919.

APPLIED CHEMISTRY.

(1) *Coal-tar Dyes and Intermediates.* By E. de Barry Barnett. (Industrial Chemistry Series.) Pp. xviii + 213. (London: Baillière, Tindall, and Cox, 1919.) Price 10*s.* 6*d.* net.

(2) *Coal-tar and some of its Products.* By Arthur R. Warnes. (Pitman's Common Commodities and Industries.) Pp. xxii + 105. (London: Sir I. Pitman and Sons, Ltd., n.d.) Price 2*s.* 6*d.* net.

(3) *Van Nostrand's Chemical Annual.* Fourth issue, 1918. Thoroughly revised and enlarged. Edited by Prof. John C. Olsen. Assistant editor, M. P. Matthias. Pp. xviii + 778. (London: Constable and Co., Ltd., 1918.) Price 15*s.* net.

(1) THIS volume, by Mr. E. de B. Barnett, is one of the series of works on industrial chemistry now being published under the editorship of Dr. Samuel Rideal. The series aims at giving a comprehensive survey of the present condition of the chemical industries, the various subjects being treated from the chemical rather than from the engineering point of view. The books appeal mainly to the advanced student, whose mind, in the opinion of the editor, "is often crammed with the hard facts and details of his subject which crowd out the power of realising the industry as a whole," and who, "on commencing his industrial career, is positively handicapped by his academic knowledge because of his lack of information on current industrial conditions." There is, no doubt, room for difference of opinion as to the best course of instruction to be pursued in the case of one who is being prepared for a career in applied science, and it may be that the change from the purely academic side to that of application has hitherto been too abrupt, and that something in the nature of an intermediate course on the principles of technology is desirable. This fact, indeed, is now generally recognised, and we have the evidence for it in the creation of such places as the Imperial College at South Kensington, and in the extension of the newer universities, such as Manchester, Liverpool, Leeds, and Birmingham, all of which have largely developed their technological side, either by the establishment of new chairs or, as in the cases of Manchester and Glasgow, by uniting themselves with schools of technology already existing. Conditions arising out of the war will no doubt accelerate this movement, not only in this country, but also throughout the British Dominions. As we know, it has given an enormous impetus to technical education in America and in Japan, and bids fair to jeopardise the industrial future of Germany, at least in the chemical arts. Whatever the future may have in store for our defeated enemy, there can be no doubt whatever that her supremacy in certain branches of manufacturing chemistry is irretrievably gone.

The book under review appears, therefore, at an opportune time, and it is one of many similar productions which aim at rousing British chemical manufacturers to a sense of their present opportunity. It deals with an industry which took its rise in this country, but was in large measure lost to us through a variety of causes, not the least of which was our deplorable educational system and the supine inactivity of public opinion which failed to insist upon its betterment. We are, however, quickly changing all that, and we may confidently hope that the coming generation will see a marked improvement. The manufacture of the so-called coal-tar dyes has already received a great extension in this country, and is rapidly assuming the position of a staple industry. It is bound to pass through many a critical phase in the near future, but the conjoint efforts of our schools of instruction, with wise management on the part of our producers, together with the benevolent attitude of Parliament, will, we trust, serve to steer it safely through its difficulties. This country will never again have such an opportunity to recover its lost position in this industry, and it would now be the height of unwisdom for it to neglect its chance.

The book before us, of course, makes no pretension to be a complete treatise on the subject with which it deals. It can scarcely be expected that a volume of some 200 pages would adequately cover so vast a field. It gives, however, a fairly satisfactory *aperçu* of the various processes involved in the manufacture of what are known as "intermediates"—that is, of compounds employed in the manufacture of actual dyestuffs, such as nitration, amidation, sulphonation, hydroxylation, etc.—and describes the mode of production and uses of the more important of these substances and of their main chemical and physical properties. This constitutes part i. of the book, and is made up of five sections, extending in all to some eighty-three pages. It is naturally highly condensed, and no attempt is made to illustrate it by any figures of the plant in actual use, which we consider an unfortunate omission. Drawings of plant, such as an engineer would make, do more to present what the editor calls "the reality of the living industry" than whole pages of verbal description.

Part ii., which constitutes the bulk of the work, is divided into fourteen sections, each dealing with a special group of dyestuffs. These sections are naturally of very unequal length, such groups as the azo-dyes, the triphenylmethane dyes, the azines, the indigoid dyestuffs, and the anthraquinone dyes—among the more important of the synthetic dyes—extending over several pages, whilst the nitroso- and nitro-dyes, the indamines and indophenols, oxazines, thiazines, quinolines, acridines, and sulphide dyes are somewhat summarily dismissed. A valuable

feature of the book is its bibliography and its summary of patent literature, which may render it of use to the works chemist. The main drawback is, of course, that such summaries in so progressive a subject rapidly become out of date.

The book concludes with a short statement concerning the possible future of a synthetic dyestuff industry in Great Britain. Here the author is on debatable ground, and certain of his views may be open to criticism. Indeed, he concedes that the question whether such an industry can be established here on a paying basis admits of a considerable difference of opinion. The high cost of transport has in the past been a severe handicap, and there can be no doubt that the railway companies have done little to promote the interests of the manufacturers; it remains to be seen, however, whether nationalisation and the re-opening of inland waterways and coasting harbours will effect the desired improvement. The author pleads for at least temporary protection to the "key" industries, and especially to the dyestuff industry, which has in effect been promised by the Government. He naturally welcomes the financial assistance by loans and grants-in-aid already made by the State for capital cost of plant and depreciation and specialised technical research, but he sees many difficulties in complying with the conditions imposed by the Board of Trade, and in his opinion the success of the whole scheme of bureaucratic administration is very questionable. He thinks a better scheme would be to establish a central "Board of Chemical Industry" on the same lines as the U.S. Bureau of Chemistry, and he gives a sketch of its constitution and functions. As it is suggested that the proposed Board should be a Government department, it is not very obvious how it differs, or at least need differ, from the organisation already proposed, as the admitted aims and duties are identical. Much, of course, depends upon facilities for the manufacture of "intermediates," and it is suggested that benzol and toluol producers might themselves convert these products and sell them to the actual dye-makers, or that the coke-oven undertakings might take over their manufacture. This would, no doubt, be a great advantage from a purely economic point of view, and allow the smaller dye-makers to compete on better terms with the larger concerns, and so tend to diminish the chance of the monopoly which the present combine is not unlikely to bring about.

(2) This little book is a member of Pitman's series of Common Commodities and Industries. It attempts to explain within the limits of 100 crown octavo pages the main features of the origin and uses of coal-tar and of the methods employed to obtain commercially valuable materials from it. Although necessarily very slight in treatment, it possesses certain features of value which are lacking in the work just noticed. It is fairly well illustrated, and its descriptions of manufacturing processes are adequate, considering its scope. The book covers, however, much less ground than Mr. Barnett's work, and it is not so much concerned with synthetic dyestuffs as with such products as benzol, toluol, sulphate of ammonia, carbolic acid, creosote, pitch, etc.—in other words, with the primary products of the tar-distiller. It appeals to the business man and the student of commerce rather than to the chemical student or the technologist. Its author is the lecturer on coal-tar distillation at the Hull Technical College, and the book is evidently based upon considerable experience of the industry. It is well written and eminently readable, and merits the attention of the special class for which it is intended.

(3) This book is now in its fourth issue. It is a type of work which is becoming increasingly common, and of which practically every country which is concerned to any extent with chemistry and the chemical arts can furnish examples. They are mainly intended for the chemical analyst, works manager, and consultant, and are compiled on very much the same lines. They consist for the most part of tables, such as the chemical and physical constants of the elements, critical data of gases, gravimetric factors and their logarithms, molecular and atomic weights and their logarithms, and a collection of useful analytical factors, physical constants of inorganic and organic compounds, hydrometer tables, specific gravity tables, thermochemical data, tables of weights and measures, a list of definitions of fundamental units of weight and mass, etc. An unusual feature is a list of arithmetical problems illustrating methods of calculation occasionally needed in industry, with their answers. Certain of these are not original, and may be found in works dealing with chemical arithmetic. But the list is fairly representative, although it might be assumed that any user of the annual would have already familiarised himself with such calculations during his studentship. The compilation concludes with a list of the more important books interesting to the chemist which have been published since October, 1913, with their prices in American currency.

The value of a compilation of this kind depends wholly upon its accuracy, and it is evident that no pains have been spared to ensure this. The most trustworthy data have been selected, and the editors have had the assistance of a competent body of experts, who have dealt with special groups. Although the work is called an "annual," it should be noted that the several editions are not necessarily revised in each successive year. The first issue appeared in 1906, the second in 1909, the third in 1913, and the present issue is dated November, 1917. Considering, however, the nature of the subject-matter, it is reasonably certain that the book has been kept well up to date, and that it fully realises its aim as a convenient reference book of numerical data.

A GEOLOGICAL BIBLIOGRAPHY OF INDIA.

A Bibliography of Indian Geology and Physical Geography, with an Annotated Index of Minerals of Economic Value. Compiled by T. H. D. La Touche. Part i., "A Bibliography of Indian Geology and Physical Geography"; part ii., "An Annotated Index of the Minerals of Economic Value." Pp. xxviii+571 and ii+490. (Calcutta: The Geological Survey of India; London: Kegan Paul and Co., Ltd., 1917 and 1918.) Price, part i., 5*s*. 4*d*.; part ii., 6*s*.

GEOLOGISTS, and especially students of Asiatic geology, owe a debt of gratitude to Mr. La Touche for having prepared, and to the Geological Survey of India for publishing, these two useful volumes, which the printer and paper-maker have made distinctly portly. The first is a bibliography of all that has been published regarding the geology of India and adjacent countries, arranged by authors, with a separate heading for all anonymous writings, and we note that Mr. La Touche has refrained from the needless pedantry of classing those unsigned contributions as anonymous of which the authorship was openly avowed and is well known. The bibliography seems very complete, for a somewhat critical search has failed to discover any omissions and has met with only one error, where two authors, who happen to have the same surname and initials, have had their separate identities merged into one person.

The second volume will probably prove of wider interest, being an annotated index to all published information regarding rocks or minerals of economic value. It is conveniently arranged in alphabetical order of the substances dealt with, and under each heading is given a brief review of recorded occurrences and production where the mineral has been worked, with references to the original authorities enumerated in the first volume. Glancing over this annotated index, we note that the production of diamonds, for which India was especially famed in olden days, had fallen to some 55 carats in 1915, the latest date quoted by Mr. La Touche, and to 18 carats in 1917, the latest date for which returns have been published. The more plebeian form of carbon, known as coal, has become a very important industry in India, and of it more than 18,000,000 tons a year are now mined. Iron, too, has become an important industry, and in 1917 nearly 365,000 tons of pig-iron and steel were produced by the two principal companies concerned in the industry.

The influence of the war on mineral production has been marked; it is apparent even in the work under review, and becomes more noticeable when it is compared with the review of mineral production during 1917. The output of tungsten has nearly doubled, more than 4500 tons of wolfram having been produced in India during 1917, mostly from the Tavoy district of Burma. Vanadium, at present one of the most keenly sought after of all metals, figures in Mr. La Touche's work by a single reference to the reputed presence of 2 per cent. in the ash of certain lignite of Travancore. Of magnesite, the production has risen from about 400 tons in 1914 to more than 18,000 tons in 1917. Mica, of which 40,000 cwt. had once been produced, fell to 27,000 cwt. in 1915, but the demand for war needs had once more raised the quantity returned as production to more than 40,000 cwt. in 1917; in the same year more than 62,000 cwt. were exported, a discrepancy which gives rise to a naive comment by the Director of the Geological Survey that "there is a thriving trade in mica theft in some of the mining areas, and stolen mica naturally does not appear in the output returns."

Such are some of the reflections which have occurred to us in examining this work, but its real value is as a book of reference. As such it will be invaluable, and the constant standby of all who are in any way concerned with the mineral resources of our Indian Empire, or with the important contributions which it has made to pure geology and the kindred sciences.

RESEARCH ON WOUNDS OF WAR.

Ambulance de "L'Océan," La Panne. Tome ii., fasc. 1. Travaux publiés sous la Direction du Dr. A. Depage. Pp. 376. (Paris: Masson et Cie; London: H. K. Lewis and Co., Ltd., 1918.) Price 18 francs net.

THIS volume contains, in the first half, articles dealing with operative and post-operative methods and results of various wounds in war. In the second half more stress is laid upon the bacteriological aspect and histological appearances of war-injured tissues. In the first article, by Dr. Depage, is a general discussion of excision and delayed primary and secondary suture of wounds. The author deals with the application of this method of treatment to various regions of the body, and lays particular stress on avoiding transverse incisions in the limbs, which, although giving free access, lead to unduly severe loss of tissue and difficulty in suture. The percentage results of success obtained are excellent.

Dr. Depage and Dr. Delrez then report on a series of cases of severe injury to the feet, with or without involvement of the bones and joints. Very good photographs and radiographs show the wounds of some of the more severe in the various stages and the final results. The authors strongly recommend the removal of the astragalus to assist in the early drainage, and very complete inversion until the tissues are clean, after which the surfaces are approximated and fixed with wire sutures.

Dr. Delrez contributes a long article upon that most controversial subject—wounds of the knee-joint. After discussing the indications for immediate amputation, he gives examples and figures of a large number of cases, dividing them into classes according to the extent and nature of

injury to the neighbouring bones. He finds that the limit of conservative operation is when there is an injury of the patella and condyles at the same time, and recommends resection and fixation for permanent ankylosis. The rest of the article discusses wounds of the ankle and wrist, elbow and shoulder, and also the treatment of septic arthritis that supervenes when the original excision of the wound fails to attain primary union. Dr. Neuman then contributes the results of laparotomies performed from June, 1915, to March, 1918. He begins with a short historical review of the treatment of abdominal penetrating wounds, and then shows the personal statistics, which clearly emphasise the importance of an advanced post for laparotomies. The article then contains a detailed classification of the different types of abdominal wounds, with the appropriate treatment for each type and the statistical results. The article by Dr. Janssen contains a valuable review of the history of cranio-plastic operations, and a detailed account of his own method of cartilaginous or osteoperiostitic heteroplastic grafts and the after-results.

Prof. Dustin contributes an article on the fasciculation of the various nerves of the arm and cervical plexus, and points out the importance of the arrangement of the fibres in estimating the prognosis of total section. Dr. Harde reports the relative frequency of the tetanus bacillus and other anaerobic organisms in a large series of wounds, and shows that very few cases ever develop clinical manifestations of the organisms, although they can be bacteriologically identified from the tissues. Further contributions on microbic growth and the mechanism of elimination of organisms from the circulation bring us to the last and longest article, by Prof. Levaditi.

This is a critical investigation into the effects of streptococcal invasion. The sections are arranged as follows: (1) The method of invasion, early and late; (2) the morphological and cultural characteristics of the different types discovered; (3) the reasons why clinical manifestations do not necessarily follow invasion; (4) hypersensibility and acquired immunity arising during the period of infection; (5) the effects of vaccination. Many charts of individual patients and details of their treatment and complications illustrate this important research.

The whole production is excellently printed and illustrated, and contains important contributions to some of the most intricate of war problems.

L. J. AUSTIN.

OUR BOOKSHELF.

Faith in Fetters. By the Rev. T. R. R. Stebbing. Pp. 223. (London: T. Fisher Unwin, Ltd., 1919.) Price 6*s.* net.

THE author, a veteran naturalist of distinction, a great authority on Crustaceans, has here raised a protest against the continuance of superstition in modern theological doctrines and religious conceptions. The conventionally orthodox attitude to the Bible is an anachronism. But he tilts too often against windmills, and there is more than a hint of wooden literalism in the examples he gives of Biblical contradictions and of anthropomorphisms which have become grotesque. The science of literature and of folklore has surely changed the educated man's attitude to the Bible much more than Mr. Stebbing's mode of treatment would suggest. The Thirty-nine Articles do not fare much better at his hands than do the Scriptures, for they are redolent with impossible anthropomorphisms. To take these literally may be superstitious, but it is surely possible to read them sympathetically as historical survivals. A theological or philosophical idea may be living and useful, though its particular form has grown musty.

From internal evidence the author shows that "the supposed inspiration and consequential infallibility of the Old Testament Scriptures rests on no solid foundation." But it seems to us that in his prosaic, unscientific treatment of the literature in question Mr. Stebbing leads his readers into a way of looking at things not less erroneous than a belief in "inspiration." If the author thinks that Church councils should make clear that they officially accept the scientific view of the Scriptures which the best modern scholars have expounded and many humble, clear-headed preachers adopt every Sunday, we are with him; but it should surely be possible to get rid of superstition without jettisoning imagination.

Le Tube Coolidge. Ses Applications Scientifiques, Médicales et Industrielles. Par H. Pilon. Pp. iii + 83. (Paris: Masson et Cie, 1919.) Price 4 francs net.

M. PILON has written an interesting and timely brochure upon the Coolidge X-ray tube. He first enters into a description of the three types of these tubes which are available at the present time, namely, the standard tube, the first model of the inventor and the one ordinarily used; Modèle A, in which attention is especially directed towards the production of a very fine focus on the anti-cathode; and, lastly, the radiator type of tube, which was designed to meet the special requirements of the American Army Medical Service; this tube is a beautiful example of the inventive genius of Dr. Coolidge, the diameter of the tube being reduced to as little as 8 cm.

The second part deals with the radiation emitted by the tubes, the data being selected from the work of Coolidge and Moore, de Broglie, and others; a number of well-chosen illustrations exhibit the conditions necessary for clearness in radiographic images.

The concluding section is, for the main part, a reply to various criticisms which have been passed upon the performance of the Coolidge type of tube. A small section is devoted to the industrial applications of X-rays, and a final word is wisely said as to the necessity for the adequate protection of operators against the powerful and penetrating radiation from the modern X-ray tube.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Inheritance of Acquired Characters.

SOME years ago I directed attention (*Eugenics Review*, January, 1917, Transactions of the South-Eastern Union of Scientific Societies, 1917) to a remarkable series of experiments by Kammerer, carried out in the Biologische Versuchs-anstalt, Vienna, the results of which were published in a number of papers appearing in the *Archiv für Entwicklungsmechanik*. In these experiments Kammerer subjected a number of species of amphibia and reptiles to the action of a modified environment throughout a period extending from their early youth until the attainment of sexual maturity, and as a result modifications, both of structure and habit, were produced. When these altered individuals were allowed to pair and produce young, these young showed traces of the influences to which their parents had been subjected in two ways, viz. (*a*) when they continued to live in the same environment, the modifications of structure and habit which had appeared in the parents reappeared in *intensified form* in the young; (*b*) when they were transferred back to the original environment proper to the species to which they belonged, they still showed, *in their younger stages of growth*, some degree of the same change in habits and structure as the parents had exhibited.

These results, as I pointed out, would, if confirmed, definitely establish the inheritability of acquired characters, one of the most fundamental questions in biology. But Kammerer's results were received by many of his zoological colleagues, not only here, but also on the Continent, with a storm of criticism. Doubts were cast on his *bona-fides*, and it became fashionable to ignore his results in discussing the laws of heredity. One of the most interesting of Kammerer's experiments had for its subject the "midwife toad" Alytes. This beast differs from other toads, and, indeed, from the Anura in general, in the circumstance that the sexes pair on land, and not, as is the rule among Anura, in the water. In all these water-breeding forms the male is provided with a horny patch situated on the hand below the index finger, in order to enable him to retain his hold of the female when he clasps her under the water. As all know, the eggs are fertilised after being laid, and the young emerge as tadpoles provided with three feathery external gills on each side of the head; but these gills become covered over by the growth of an opercular fold from the hyoid arch and then atrophy, and are functionally replaced by more internally situated gills.

In Alytes the male is devoid of the horny patch on the hand, as the skin of the female, being comparatively dry, is sufficiently adhesive to allow him to retain his hold without it. When the eggs are laid—as is usual amongst toads, in long strings—the male, after fertilising them, winds them round his legs, and thus encumbered he lives in seclusion for several weeks until the young are ready to hatch out. He then visits the water, and the young emerge as advanced tadpoles, in which the external gills have already been covered over. The eggs are fewer in number, much larger in size, and more abundantly provided with yolk than those of other Anura.

Now Kammerer states that if Alytes be kept under conditions of greater warmth than they are normally accustomed to, they will live and flourish if provided with a tank of water in which they can bathe if they feel so inclined. In these circumstances they begin to pair in the water, and the eggs slip off the legs of the male and lie in the water. Most perish, but, by keeping the water aseptic, a few will develop. These, reared to maturity, produce, when sexually ripe, more numerous eggs of smaller size than is normal to the species, and the young hatch out at an earlier stage of development. If we open the egg of a normal Alytes, we discover that the *embryo* is provided with only *one* external gill on each side. Now in this F_1 generation the tadpoles emerge in this stage, and Kammerer figures free-swimming tadpoles of Alytes with one large external gill on each side. When the F_1 tadpoles are reared to maturity, they pair in the water and give rise to tadpoles with *three* external gills on each side, and these tadpoles, reared to maturity, develop into *males with a horny patch* on the finger.

Concerning this experiment, our leading authority on genetics, Prof. Bateson, thus speaks in his latest book ("Problems of Genetics," p. 201):—"To my mind this is the critical observation. If it can be substantiated it would go far to proving Kammerer's case. The figures which Kammerer gives [of the horny patch: E. W. M.] are quite inadequate, and as they merely indicate a dark patch on the thumbs, it is not possible to form any opinion as to the nature of the structure they represent. . . . I wrote to Dr. Kammerer in July, 1910, asking him for the loan of such a specimen, and on visting the Biologische Versuchs-anstalt in September of the same year, I made the same request, but hitherto none have been produced."

Now during the war it has been difficult to obtain German scientific publications, but, through the kind permission of the Board of Trade, we have been enabled to import all the numbers of the *Archiv für Entwicklungsmechanik* published during the war. In the latest of these, published in Berlin early in the present year, there is a paper by Kammerer in which he gives the results of further rearing of Alytes under conditions of greater warmth than normal. His original description of the horny patch on the hand of the male was based on its appearance in males of the F_2 generation, but he describes now males of the F_6 generation, in which the horny patch is so marked that its development exceeds that in the normal male toad (Bufo). He gives photographs of two Alytes males side by side, one of a normal male, one of a modified male, and in this latter the horny wart can clearly be made out. Further, he gives a whole plate of figures of sections through the skin of the hands of normal and modified males, and the last show unequivocally the characteristic horny papillæ which make up the patch.

It must, we think, be conceded that Kammerer has fairly taken up the gauntlet thrown down to him by Prof. Bateson, and the present position of the matter is that a strong *prima-facie* case for the inheritability of acquired variations has been made out. Of course, it is open to those who have attributed fraud to Kammerer to assert that the whole of the evidence adduced in this paper has been manufactured out of whole-cloth, even though the photograph of the modified male is stated to have been taken by an American student in Vienna and not by Kammerer himself. Such doubting Thomases could be convinced only by a journey to Vienna and an inspection of the modified males, for it is unreasonable to expect Kammerer to send these priceless specimens to any zoologist who chooses to doubt his word. It is to be hoped that,

once peace is signed, this journey will not be delayed. Meanwhile, the average zoologist who reads Kammerer's paper may be pardoned if he feels that the hypothesis of wholesale premeditated fraud is a difficult one to sustain.

It may perhaps be said that no notice should be taken of Kammerer's results until some other investigator repeats them. Such a course is not pursued with regard to any other zoological investigations. When new discoveries are published we thankfully receive them. We keep, perhaps, an open mind until they are repeated, but freely concede that a *prima-facie* case has been made out for them.

To Mendelian critics I would point out that the difficulty of instituting experiments designed to test the inheritability of acquired characters is colossal. Compared with them, the carrying out of experiments in Mendelian inheritance is child's play. With the kind concurrence of Dr. Chalmers Mitchell, I have persuaded Mr. E. Boulenger, Curator of Reptiles, to make preliminary arrangements to have some of Kammerer's experiments repeated in the Zoological Gardens. I found that a minimum of six years would be required before decisive results could be obtained. This new paper of Kammerer's appears to represent the result of seven or eight years' work. The proper rejoinder of the Mendelian is not to gibe at the absence of confirmatory evidence from other investigators (and some even of this is available), but to obey the Scriptural injunction, "Go thou and do likewise."

E. W. MACBRIDE.

Imperial College of Science, May 7.

The Conditions attached to Government Grants for Scientific Research.

MAY I again direct attention to the conditions under which grants are made to individual research workers by the Committee of the Privy Council for Scientific and Industrial Research (London: H.M. Stationery Office, 1919. Price 6*d*.)? The matter is of some importance, as not only are those who refuse to accept these conditions debarred from participating in the grants made from the public purse for scientific research, but other sources which used to be available, and to which such conditions were not attached, are also being cut off. I understand, for example, that the Carnegie Trust for the Universities of Scotland intends very largely in the future to discontinue its grants in aid of research, and to refer applicants to the Government.

By accepting a grant under these conditions, a research worker undertakes not to publish his or her results without the consent of the Committee, and gives up the ownership in the commercial rights of his discoveries, which otherwise, under the Patent law, belong to him. It is the Committee, not the inventor or discoverer, that is to determine to what extent and in what proportion the Committee and those who have made the discoveries are to secure the ownership of the results by patent, presumably on the ground that the Committee has provided the funds for the research. If that is the ground, ought not the Committee to state precisely what is the share it claims, whether the share is limited to the amount of the monetary contribution, or if it intends to make a profit? I understood the money was given by Parliament to foster research, not to exploit it. As it is, a worker accepting a grant places himself absolutely, as regards the legal right to his own property, in the hands of a Committee, and if, as is bound to occur, differences arise as to what is the share of the discoverer or who is the discoverer, the matter is not put into the hands of an impartial arbitrator to settle, but is settled by one of the parties in the dispute. In precisely the same way, with existing secret patents, if a dispute arises between a patentee and the Government, it is the Treasury, who pays for the use of the patent, that settles the dispute.

The condition is justified on three grounds. First, on the ground of national interest, especially in the present abnormal circumstances, and that it is not in the national interest that results of commercial value should be made available to other countries to the detriment of our own. As regards actual war conditions, patents containing any information likely to be of use to the enemy have not been published, so this is secured independently of the question of the ownership of the patent. As regards the future, one is justified in asking whether it is the intention of the Committee that the results of researches obtained by the expenditure of national funds should be kept secret, as most scientific men would regard this as short-sighted.

The second ground is that, where results are to be patented, delay in publication is in the interest of the investigator. This is scarcely relevant. It is surely in the highest degree dangerous to delay applying for a provisional patent until the results have been communicated to the Committee and its consent obtained, for any person who, by lawful or unlawful means, gets the information is then in a position to prevent the real discoverer from protecting himself.

The third ground is that it is the object of the Department to secure to the discoverer a fair share in any profits that may accrue from his discovery. Admittedly, the class of inventors and discoverers is in very great need of being protected from the sharp practices that have sprung up under the shadow of the Patent law, and primarily from the Government itself. But why should a small part of them, who receive Government funds, be singled out and protected? If the discoverer prefers to secure for himself the legal ownership of his discoveries, rather than for the Committee, I do not think he should be debarred from participating in this money. The most, I think, the Committee has a right to stipulate is that its interest is limited to the amount it has contributed, and that, in the event of a dispute, the matter shall be referred to an impartial arbitrator for settlement.

FREDERICK SODDY.

THE ATLANTIC FLIGHT.

THE attempt to cross the Atlantic by aeroplane, though as yet unsuccessful, has produced one record-breaking long-distance flight. The American seaplane, NC4, has flown from Newfoundland to the Azores, a distance of 1380 miles, thus establishing a record for distance. Trepassey Bay was left on May 16 at 10.05 p.m. G.M.T., and Horta, Island of Fayal, Azores, was reached at 1.23 on the following afternoon, the duration of the flight being 15 hours 18 minutes.

Mr. Harry G. Hawker and Commander Mackenzie Grieve started from St. Johns, Newfoundland, on May 18, at 5.45 G.M.T., for a direct flight to the British Isles, but no news has since been heard of them. It is greatly to be regretted that this daring attempt has failed, and we sincerely hope that the two brave aviators, who flew the Sopwith machine, have been rescued by a passing ship.

It is probable that Mr. Hawker's failure was due to bad weather, and in this respect it seems a pity that so difficult a feat should have become a race between various competitors. Had Mr. Hawker waited until the weather conditions were really favourable, there seems little doubt that he would have succeeded.

In considering the present situation, it is well to realise the immense progress that has been made in the last ten years. In 1909 Blériot first flew across the Channel, and his feat was then regarded in very much the same light as is the Atlantic flight to-day. We must, therefore, not be discouraged by the failure of the first attempt to fly direct from the New World to the Old, and although the Atlantic flight cannot now be considered as a commercial project, it may well be that in ten years' time it will be as simple an undertaking as a commercial flight from Paris to London is at the present day.

It is worthy of note that the great progress in flying range made since Blériot's Channel flight has been due in great measure to improvements in the engine, and only secondarily to better aerodynamic design. It is highly probable that engine improvement will be the main factor influencing the development of long-distance commercial flying in the future.

The main difficulty of trans-Atlantic flying will always be the weather, but it is to be hoped that an extended research into the meteorological conditions at various altitudes will do much to simplify the problem by enabling aviators to choose the most favourable route and altitude of flight.

Meanwhile, we can but await the attempts of other competitors for the honour of the Atlantic conquest by air, in the certainty that effort will not be relaxed until the flight is accomplished, and in the hope that Mr. Hawker and his navigator have been spared to make another attempt.

Trans-Atlantic Flying and Weather.

It cannot be too well understood that a flight from Newfoundland to the Azores at this time of year is vastly different from a flight to the British Isles. The Azores flight is made within a zone where fair weather prevails. The stages to Lisbon and thence to Plymouth may offer considerable difficulties. For seaplanes, and with look-out vessels fairly close to hand, the risk to life is greatly lessened.

So far as the direct flight from St. Johns, Newfoundland, to the British Isles is concerned, it is at present not easy to minimise the risks. Weather undoubtedly is the controlling factor. There are usually exceptionally few days in the year when the North Atlantic is free from cyclonic disturbances, but of all seasons the present time is probably normally the most favourable. The conditions, however, vary so immensely in different years that to choose a period for a trans-Atlantic flight without reference to the actual existing weather conditions involves immense danger. For a practically safe flight eastwards the prevailing distribution of atmospheric pressure over the Atlantic should be anticyclonic, with direct indication that no cyclonic disturbances exist along the route. In these conditions, which synchronous charts of the Atlantic show to exist occasionally, aircraft would have a steady westerly wind over the whole course. On the other hand, when cyclonic disturbances are known to exist in the open Atlantic, as they have for several days past, and for a much longer period, stormy and probably adverse winds would have to be negotiated for a considerable distance. The information given in the International section of the Daily Weather Report, issued by the Meteorological Office, which includes wireless reports from the Atlantic, shows what complete data have been available for those taking part in the flight. A moderate south-easterly gale was blowing at the surface well to the westward of the Irish coast at the time of the eastern flight, whilst nothing definite was known as to the direction and velocity of the upper air. Information as to the drift of the air over the open sea in any part of the world is of the crudest form, although even that might be of great value.

THE DEVELOPMENT OF AGRICULTURAL RESEARCH AND EDUCATION IN GREAT BRITAIN.

IT was for long a reproach to this country that so little attention was paid to agricultural research and education. The first step to remedy this state of affairs was taken in 1910, when Mr. Lloyd George set up the Development Commission and provided it with funds for the promotion of research and of various schemes and methods calculated to assist the agricultural industry. Out of its funds the Commission in 1911 made a grant to the Board of Agriculture of 50,000*l.* per annum for the carrying out of the Board's scheme to promote agricultural research and education, and this sum was allocated to various institutions and colleges, thereby allowing much-needed extensions of laboratories and staffs. It is a condition of the grant that a report on the work of the institution should be sent each year to the Board, and these reports as published have been duly reviewed in the columns of NATURE.

There is little doubt that this grant saved the agricultural colleges and research institutions from losing their best men. Up to 1910 it was recognised that a good man had little prospect in this country, and must perforce seek for posts overseas, either in some part of the Empire or in the United States. A score of names can be recollected of men who went, not primarily because they wanted to go, but because they saw no alternative. Although a few stayed on, they recognised the risk they ran. Had nothing occurred to justify them, the profession would soon, and deservedly, have acquired a bad reputa-

tion, and few desirable recruits would have entered it.

All this was changed in 1910 with the appointment of the Development Commission, and the thoroughness with which that body did its duty by encouraging agricultural research and education deserves wide recognition. Colleges and research institutions were enabled to build up staffs with adequate technical knowledge and expert in studying agricultural problems. The country has already derived considerable benefit; during the war it must have recovered most of its expenditure as a result of having at its service a body of experts already trained, instead of having to wait until new men could learn the work.

After eight years of its first scheme the Board of Agriculture is clearly satisfied with the results, for it has now decided on a still further development. The Board's proposals involve an expenditure on agricultural research and education, not of 50,000*l.* a year, but of 400,000*l.* a year. Research, it is understood, is to be subsidised at the rate of 100,000*l.* a year; the colleges are to receive 50,000*l.* a year; the remainder is intended for country and other work.

A certain number of men (and presumably of women also) who have distinguished themselves in natural science at the universities will receive scholarships that will enable them to specialise in agricultural science and to fit themselves for appointments at research institutions and agricultural colleges. A scholarship scheme has been in existence since 1911, and useful experience has been gained of its operation. Perhaps the most notable feature of this accumulated experience is the serious responsibility placed on the teacher who nominates a candidate. It has happened that unsuitable men have been put forward by well-meaning sponsors who realised that their candidate was not quite good enough for pure science, but hoped he might do for agriculture. Indeed, one or two schools of pure science are in rather bad odour at agricultural institutions for this reason. Unfortunately agricultural science, while offering excellent careers for men of the proper outlook and calibre, is the blindest of blind alleys for those who are unsuitable.

Given the right type of man, a career will be open to him. At the present time there are some forty permanent research posts at the agricultural institutions. It is proposed (according to the *Times*) to raise this number gradually to 150. The salaries, we learn from another source, will compare favourably with those offered at the universities, the headship of a small department being equivalent to a senior lectureship and that of a large department to a professorship; in addition, the university superannuation scheme is to apply. The work, we know, is of the highest interest and importance.

Agricultural education is also to be developed. There are already in existence a number of agricultural colleges to serve the country—in England and Wales alone there are about twelve, without counting the Scottish and Irish colleges—and they will receive further grants enabling them to develop on more extensive lines.

The work of the colleges is mainly related to the needs of the coming generation of farmers; it is proposed, however, to bring them into closer touch with men at present farming by the establishment of demonstration farms and other organisations calculated to achieve the same purpose.

At the present time the link between the college and the school is not very definite; we have in this country very few schools similar to the Rural High Schools of the United States. Oundle among the large schools, and Dauntsey and Brewood among the grammar schools, have agricultural sides where boys receive the proper training preliminary to an agricultural college course, but there are few places to which a farmer or labourer could send his son if for any reason the long school and college course were not possible. It is proposed to erect more farm institutes where intelligent boys can go for winter courses, and girls can be taught in summer; a certain amount of this kind of work has been done, and its value demonstrated. Finally, there is to be provision for giving short courses to school teachers who will be engaged in the new continuation schools in rural districts.

Although full details are not yet published, sufficient is known to show that the scheme is of the first importance, and the Board of Agriculture is to be congratulated on the bold lines of the proposal. The scheme has yet to be accepted by the House of Commons, and may undergo changes; it cannot be fully discussed until it is officially published in all its details. For the moment the great point for satisfaction is that the Board of Agriculture has shown itself so completely alive to the need for research and education, and has so fully satisfied itself that science can help agriculture. The band of scientific workers who have rendered such devoted service during the probationary period may also be congratulated on the result of their labours.

Some of these workers have themselves issued through the Agricultural Education Association a memorandum on the reconstruction of agricultural education in England and Wales,[1] which is of interest as showing their side, and will be of still greater interest when the Board's scheme is finally issued. The memorandum is very wide in its scope, and deals with rural continuation schools, county work, farm institutes, agricultural colleges, university agricultural education, agricultural research, dairy education, horticultural education, poultry-keeping, co-operative experimental work, experimental and other farms, status of workers, and co-ordination in educational work. The general summary is contained in sixty-two paragraphs at the end, and as it relates largely to matters of detail it cannot well be further shortened. In the main the 1911 scheme is judged to have succeeded, though it now needs consider-

[1] Obtainable from the Secretary of the Agricultural Education Association, Harper Adams Agricultural College, Newport, Salop.

able amplification and, of course, more money. The need is emphasised for more county work, more farm institutes, more experimental farms, and valuable information is given as to the best methods of carrying out the purpose of these various institutions, but no great change is suggested. It is entirely satisfactory to everyone concerned that the men who have had to carry out the scheme should regard it so favourably. The foundations have already been well laid; let us hope the building will be worthy of its purpose.

E. J. Russell.

THE FINANCIAL POSITION OF CAMBRIDGE UNIVERSITY.

The University of Cambridge in general, and its scientific departments in particular, find themselves in a grave position financially as a result of the diminution of the value of money brought about by the war. Towards the end of last term the heads of the scientific departments presented to the Council of the Senate a statement showing that to provide for the efficient working of their departments on the pre-war scale, without making allowance for any extension of activity, an additional income of 17,000*l.* was required to meet the increased cost of wages and maintenance. They further pointed out that in addition to the higher cost of living a new factor had arisen, in that various departments had to face an increased competition with activities outside the University for the services of the most competent scientific men; and they were of opinion that an average increase of 50 per cent. in the pre-war payments to the teaching staff was required if the University was to continue to command the best scientific talent in the country. This increase of stipends would require an additional income of 15,000*l.*, making 32,000*l.* in all.

In November of last year the acting vice-chancellor received a letter from the President of the Board of Education inviting him to send a statement as to the needs of the University in order that "the Government should obtain a conspectus of the needs of higher education over the whole country." In response to this request the acting vice-chancellor sent a summary of the prospective needs of the University, and in March an informal deputation, consisting of the master of Caius, the president of Queens', the master of Downing, Dr. Stewart, Sir J. Larmor, and Sir W. J. Pope, waited on Mr. Fisher for the purpose of laying before him the financial difficulties of the University.

On April 16 Mr. Fisher sent a letter to the vice-chancellor informing him that the Government would not feel justified in sanctioning a grant to the University out of Parliamentary funds except on the condition that in due course a comprehensive inquiry into the whole resources of the University and its colleges, and into the use which is being made of them, should be instituted by the Government. Subject to the acceptance of this condition by the University, the Government would be prepared to instruct the Standing Committee which is to be formed to advise the Government concerning grants to universities and colleges to submit recommendations with a view to an emergency grant being made to the University during the current financial year to meet the immediately urgent needs of salaries and maintenance. The Government would also be prepared, after the completion of the inquiry, to consider, in conjunction with the University, if it should so desire, the conditions under which a grant designed to meet the permanent requirements of the University might be made.

This letter was communicated to the Senate, and the proposals which it involved were formulated by the Council and submitted for discussion in the Senate on May 13. In the important debate which took place the proposals were supported by a number of the most prominent members of the University, including the provost of King's, Sir J. J. Thomson, the president of Queens', Sir W. J. Pope, and Prof. Sims Woodhead. They were opposed by the master of Corpus, Mr. Whibley, and, in part, by Dr. E. H. Griffiths. The question as to whether the University is prepared to accept financial assistance from the Government under the conditions laid down in Mr. Fisher's letter will probably be submitted to the vote of the Senate in the near future.

The discussion in the Senate was opened by the vice-chancellor with the announcement that a munificent gift had been offered to the University, the British oil companies having agreed to join together in a scheme for endowing the chemical department, the Burma Oil Co., the Anglo-Persian Oil Co., and the Anglo-Saxon Petroleum Co. each offering 50,000*l.*, Lord Cowdray and the Hon. Clive Pearson between them 50,000*l.*, and Mr. Deterding 10,000*l.*, making a total of 200,000 guineas. This generous offer to one of its great scientific departments meets with very high appreciation in the University.

THE GOVERNMENT OF INDIA AND SCIENTIFIC MEDICINE.

Sir Leonard Rogers's recent presidential address to the Indian Science Congress at Bombay is a forcible protest against the long conflict between scientific enthusiasm and official apathy. The benefits conferred on long-suffering humanity by scientific investigation have strangely not sufficed to remove this dull resistance. Twenty years ago the present writer made a note in the visitors' book at the leper station of Almora to the effect that no systematic investigations were being made in India into the terrible disease leprosy. It is true that individual workers here and there in India, among them Sir Leonard Rogers, have carried on researches, but what concerted efforts has the Government of India made towards stamping out the disease, and where are the leprosy laboratories with their staffs of trained investigators? The cause and mode of transmission of elephantiasis and allied conditions

are known, but what has been done towards mapping out the distribution of these diseases, making a survey of the mosquitoes known to transmit them, and eradicating these mosquitoes? Again, are the investigations carried on in India in respect of malaria at all commensurate with the magnitude of the problem? Has kala-azar, one of the deadliest of diseases, been systematically attacked except by the enterprise of commercial companies? We are aware that a few commissions have investigated and reported on the epidemic outbreaks of this disease, but more than that is required, viz. patient, systematic research. Fortunately, this hitherto incurable disease appears to be now readily curable by tartar emetic, and if research can discover the mode of transmission of the disease the possibility of its extermination is great.

Sir Leonard Rogers points out the value of "team" work. No better examples could be given than the researches made through force of circumstances during the war on malaria and dysentery. It is this team work that is required in India, and, indeed, we have one excellent example of it, viz. the work of the Plague Commission. In our indictment of official apathy we had written on the subject of that devastating, widespread disease ankylostomiasis, or hookworm disease, but even as we wrote we learned that the Government of Bengal is instituting a campaign against it. If it be said that medical research is not being neglected in India, that large sums of money have recently been devoted to it, and that tropical schools are being formed in Bombay and Calcutta, we would say that these are good signs, but we still want more proof that those in high places are purged of their ignorance, and that at last the claims of scientific medicine are fully admitted.

J. W. W. S.

NOTES.

THE Croonian lecture of the Royal Society will be delivered on Thursday next, May 29, by Dr. H. H. Dale on "The Biological Significance of Anaphylaxis."

SIR J. J. THOMSON has been appointed by an Order of Council to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

THE PRINCE OF WALES, Sir J. J. Thomson, Master of Trinity College, Cambridge, and president of the Royal Society, and Sir Norman Moore, Bart., president of the Royal College of Physicians, have been elected to the Standing Committee of the British Museum.

THE PRINCE OF WALES will be proposed for election to the Royal Society at to-day's meeting. He will be elected under the rule which provides that a prince of the blood royal may be proposed at an ordinary meeting of the society by any fellow, and may be put to the vote for election on the same day, provided that public notice of such proposal has been given at the preceding meeting.

AT a meeting of the Royal Society held on May 15 the following candidates nominated by the council were elected fellows of the society:—Prof. F. A. Bainbridge, Dr. G. Barger, Dr. S. Chapman, Sir C. F. Close, Dr. J. W. Evans, Sir Maurice Fitzmaurice, Dr. G. S. Graham-Smith, Mr. E. Heron-Allen, Dr. W. D. Matthew, Prof. C. G. Seligman, Prof. B. D. Steele, Major G. I. Taylor, Dr. G. N. Watson, Dr. J. C. Willis, and Prof. T. B. Wood.

THE Cullum geographical medal of the American Geographical Society for the present year has been awarded to M. E. de Margerie, the translator into French of Suess's "Das Antlitz der Erde," and an acknowledged authority upon the physical geography of the United States of America.

MR. W. R. DUNLOP referred in his letter on the cultivation of sponges, published in NATURE of May 8, to the present position of the subject in relation to the Colonial Office. We understand that nothing has been officially decided there in regard to a marine zoologist for the Imperial Department of Agriculture (W.I.), but the subject of sponge culture is engaging attention, and the question of sending a marine zoologist to study sponges in the West Indies will shortly come before a Committee.

ON Tuesday next, May 27, Prof. W. H. Bragg will deliver the first of two lectures at the Royal Institution on listening under water (the Tyndall lectures). On Thursday, May 29, Sir Valentine Chirol will give the first of two lectures on the Balkans. The Friday evening discourse on May 30, at 5.30 o'clock, will be delivered by Sir John Rose Bradford on a "filter-passing" virus in certain diseases. The closing discourse of the session will be given on June 6 by Sir Ernest Rutherford on "Atomic Projectiles and their Collisions with Light Atoms."

THE Research Defence Society has presented to the Home Secretary a protest against the Dogs' Protection Bill. Although the signing of such a document by physiologists may perhaps be regarded as natural, it is noteworthy that we find also the names of all the leading members of the medical profession, many dignitaries of the Church, men of affairs, and members of the legal and literary professions. It is pointed out that the passing of the Bill would be disastrous to the future of medical science in this country, while the interests of national health and efficiency would be seriously prejudiced. The latest report of the Medical Research Committee is referred to as showing the service rendered by physiological experiments, for which the use of dogs is essential.

MR. H. S. BALL, late Assistant Inspector of Mines, G.H.Q., France, has communicated a valuable account of the work of the miner on the Western front to the Institution of Mining and Metallurgy (Bulletin, April, 1919, pp. 1–53). One of the most interesting sections of the paper is that which deals with mine listening instruments. The geophone, which reproduces the sound exactly, magnifies the intensity two and a half times. A single instrument is used when the object is merely to detect the existence and nature of sounds made by enemy miners, and a pair when the direction of the source of sound is required. The two geophones are placed on the ground about 18 in. apart, each connected with an ear of the listener, and they are moved until the sound is reproduced equally in both ears, the direction of the sound-source being then at right angles to the line joining the geophones. Observations were made at the end of a gallery, and, owing to the danger incurred at such a post and to the need for economising man-power, the seismo-microphone came into use, as many as fifty galleries being connected up to a switchboard of a central lis-

tening chamber, situated in some quiet spot behind the mining system. When sounds were heard in any particular gallery a listener was sent there with geophones to investigate. The enemy is known to have used several types of mine listening instruments, but no trace has been found of any instrument for the determination of direction.

ANNOUNCEMENT is made of the death of Gen. Stefanik, who may be better known to astronomers as Dr. Milan Stefanik, formerly attached to the Meudon Observatory. Dr. Stefanik was the son of a Slovak pastor, and about 1905, being then quite a young man, but already a doctor of science of Prague University, joined the Meudon Observatory as pupil astronomer, and, at the invitation of Dr. Janssen, proceeded to Spain with the expedition from that observatory to observe the total solar eclipse of August 30, 1905, and made spectroscopic observations on that occasion. During the succeeding year he pursued spectroscopic investigation of various kinds at Meudon, showing ingenuity in improving apparatus, and made a special study of the infra-red spectrum. In 1906 he went, with others of the staff, to the subsidiary observatory at Mont Blanc, where he continued his study of the infra-red from the point of view of telluric absorption, making his observations from different altitudes on the mountain. In 1910 Dr. Stefanik established at his own expense an observatory in the island of Tahiti to pursue his researches, and was therefore conveniently placed to observe the solar eclipse of April 28, 1911, when the line of totality crossed the Pacific. He made the short journey to the island of Vavau in the Tonga group, where he had for his neighbours the British observing parties under the leadership of Dr. W. J. S. Lockyer and Father Cortie, and, though the weather was not entirely favourable, it is believed that he obtained some successful results. In December, 1911, he was awarded the Wilde prize by the Paris Academy. At the outbreak of the war Dr. Stefanik was in Paris engaged in scientific work, and he at once joined the French Army as a private soldier, refusing a scientific appointment offered him by Marshal Foch. Shortly, however, he accepted commissioned rank, and rapidly passed through all grades to that of general. He met his death at a comparatively early age in an aeroplane accident in a flight from Italy to Bratislava, the capital of his native land of Slovakia.

As already announced, Col. D. Rintoul, senior science master and head of the physics department of Clifton College, died at Clifton on April 21 of pneumonia. Born at Forteviot, Perthshire, in 1862, Rintoul received his earlier education at St. Andrews and Edinburgh; he proceeded to Corpus Christi College, Cambridge, in 1881, and eventually became a fellow of his college. In December, 1885, he was appointed senior physics master at Clifton in succession to the late Prof. Worthington, who had left to become headmaster of the Royal Naval Engineering College, Devonport. With Rintoul in charge of physics and Shenstone of chemistry, Clifton more than maintained its prominent place among public schools for science teaching. Rintoul's own words, "If a teacher is wise he will encourage all independence of thought," best show the principles upon which he acted in school, while his firmness of character, quickness, and directness made his teaching distinctive. From 1904 to 1918 he was a housemaster. Always a keen soldier, Rintoul joined the 2nd Gloucester R.E. in 1888, retiring after some twenty years' service with the honorary rank of lieut.-colonel; he held the Territorial officers' decoration, and on the formation of the T.F. was nominated by the War Office as one of the military representatives on the T.F. County Association. When the late Major H. Clissold left Clifton in 1914 to raise a field company, Rintoul came out of his retirement, and again took command of the school corps, bringing it to a high state of efficiency, and for this service was specially thanked by the War Office. Rintoul's busy life made it impossible for him to do much original research, yet the many novel features of his own laboratory reflected his marked mental alertness and his live interest in all recent developments of his subject. Shortly before his death he gave valuable help to the Secondary School Examination Council. His elder son, Lieut. D. W. Rintoul, R.A.M.C., was killed in Flanders in 1914.

SIR W. RIDGEWAY contributes to the *Quarterly Review* for April an interesting paper on the subject of ancestor worship and the Chinese drama. He remarks that it is not merely triumphs and victories that are the themes of early dramas, any more than they are in the most advanced. They are drawn from appalling catastrophes and striking reversals of fortune, as in the Muharram celebrations of the Shiah Mohammedans, and in many examples from Greece, China, and Japan. There is no need to assume that China borrowed these themes from Greece or Greece from China, as such honouring of the dead is worldwide. Neither in China nor anywhere else did tragedy arise from the worship of seasonal or vegetational abstractions, but in the veneration and worship of the dead.

IN *Folk-lore* (vol. xxix., No. 4) Miss W. S. Blackman contributes an interesting article on the rosary in magic and religion, largely based on the extensive collection in the Pitt-Rivers Museum, Oxford. The use of the rosary, which claims high antiquity in the East, is based on that of knots as mnemonic signs, the highest development of which appears in the Peruvian Quipus. The Mohammedan form is usually assigned to Buddhism; but tradition and passages in the earlier literature point to a primitive type of rosary, such as would not be used if borrowed from a people who already possessed it in a highly developed form. The period of its introduction into Europe is usually fixed as that of the Crusades; but we learn from William of Malmesbury that Lady Godiva, wife of Count Leofric, who died before 1070, had a circlet of gems which she used in reciting her prayers. It seems, therefore, probable that the rosary has been evolved independently at more centres than one from the use of knots as mnemonic records.

THE *Avicultural Magazine* for May contains a temperately worded and convincing plea for the establishment of a bureau of economic ornithology, which, we trust, will be productive of good results. The urgency of the need for such an addition to the Board of Agriculture is, unfortunately, far from being realised, and it is highly probable that any attempt to press this matter would be met with the assurance that the time for such a scheme was not opportune, nor would its cost be justified. We fear that Dr. Collinge, the author of the article, is preaching to deaf ears, but sooner or later even the Board of Agriculture may be induced to listen to his plea.

THE development of the pericardiaco-peritoneal canal in the dogfish (Scyllium) and Acanthias has been re-examined by Mr. E. S. Goodrich (*Journal of Anatomy*, vol. liii., part 1, pp. 1–13, October, 1918). This canal leads in the adult from the pericardial to the peritoneal cœlom, and opens into the latter by paired apertures. Balfour suggested that the canal is a remnant of the wider communication between the two

cavities in the embryo, but Hochstetter (1900) maintained that the early communication between the cavities became closed completely, and that the canal opening from one to the other in the adult is a new formation. Mr. Goodrich shows, with the help of excellent figures, that Balfour's original view is essentially correct, and that Hochstetter was mistaken in his interpretation.

AMONG the Notes from the Laboratory of the Wisconsin Geological and Natural History Survey is one (No. 11, issued December, 1918) by Mr. R. A. Muttkowski on a qualitative and quantitative survey of the fauna, with special reference to the insects, of Lake Mendota, which has an area of about 15 square miles and a maximum depth of 84 ft. That it forms a rich collecting ground is evidenced by striking records, *e.g.* a Myriophyllum plant with seven branches, totalling a length of 4 metres, held more than 15,000 specimens of *Hydra fusca*. Larvæ of *Corethra punctipennis*, which are abundant in the lake, are found in daylight in the bottom mud, where they chiefly hunt their food, but at night they come to the surface. Catches made in the summer of 1916 by means of a dredge showed that the number of larvæ in a square metre of the bottom ranged from 2000 to 18,000. Despite the transparency of the larva and pupa, these are eaten in large numbers by the fish of the lake, perch gorged with these larvæ being frequently found. The larvæ of the Ceratopogonine genera Palpomyia and Probezzia, when grasped in the water, straighten out and become rigid—one of the few cases where aquatic insects feign death in their normal environment. These larvæ are slender and elongate, and also resemble in their colour the filamentous algæ among which they live, but, nevertheless, they are frequent in the stomachs of the lake-fish. The author cannot confirm Prof. Miall's statement that those larvæ of Chironomus which live at the bottom and burrow in mud possess hæmoglobin, while those which live near the surface have colourless blood. He emphasises the absolute lack of any correlation between colour and oxygen-supply.

MR. W. G. CRAIB (Notes from the Royal Botanic Garden, Edinburgh, vol. xi., November, 1918) has investigated the regional spread of moisture in deciduous-leaved trees during the felling season—that is, from late autumn until early spring. The species selected for examination was the sycamore (*Acer pseudoplatanus*), and the results, which are indicated by graphs and coloured diagrams of cross-sections, show that at the beginning of the season the centre of the tree is very wet, and at the end of the season there is a very wet region almost on the outside, while the centre is very dry. Between these two extremes are all the intermediate stages. The processes during the season are interpreted as follows: As the result of the water moving inwards from the outer zones, beginning at the base of the trunk, there is created an area of maximum moisture content, in any given cross-section, at the centre of the trunk. This inward current and the consequent plane of maximum moisture content at the centre gradually extend upwards in the trunk to the topmost region; but before this is reached and the centre of the trunk at the top of the bole has become a region of maximum moisture content, a radial movement has begun at the bottom of the trunk. This radial movement also progresses upwards, and by its means the region of maximum moisture content passes almost to the outside of the trunk, leaving the centre the driest region. The movements upwards and radially, both inwards and outwards, are going on synchronously at different levels in the trunk. The expressions "the sap is down" in autumn and "the sap is up" in spring are, therefore, meaningless; we should say rather "the sap is in" (the centre) or "the sap is out" (near the bark). These results in water-distribution are confirmed by experiments on other trees, and should do much to remove the prejudice against summer felling. The new facts brought to light also raise points of scientific interest as to the explanation of the activities in the tree during the so-called dormant period, or the reasons for the arrangement of the various pits in the tissue-elements.

THE Sub-Committee of the Food Investigation Board has issued an interim report on refrigerator-cars, in which many improvements are suggested which could be carried out on existing cars, and others which could be applied in designing new cars. On the whole, the report reveals an unsatisfactory state of affairs, with divided responsibility falling partly upon the owners of the goods and partly upon the railway companies. Tests were made on several cars, both standing and running, showing that the insulation is not so effective as is desirable; that the deficiency in air-tightness is a serious matter; and that the practice of icing the ice-tanks is altogether inefficient. Another point worthy of note is the fact that the cubic capacity of cars now in use is much in excess of what they can carry when they are charged up to the safe load with frozen produce. This is rather an unfortunate state of things. It is well known that in order to obtain the best results in a chamber containing frozen produce it is desirable that it should be filled and well stowed, whereas in some cases the Committee found quite 35 per cent. of the car-space was vacant. This defect might be remedied by so designing the axles, etc., as to allow the present cars to be loaded to their capacity. The Committee would have pleasure in receiving from railway companies designs for refrigerator-cars embodying its recommendations.

A CORRESPONDENT forwards us a newspaper cutting from South Africa directing attention to the possibilities of the prickly pear (Opuntia, spp.) as a source of industrial alcohol and other products. The plant in question covers thousands of acres of good soil in South Africa, and is a pest to farmers. To utilise it profitably would be a notable achievement in turning a waste product to account. Syrup can be obtained from the plant, the seeds contain an extractable oil, and an official report made some years ago is quoted as indicating that alcohol might be produced from the "tunas" or fruits at a relatively low cost. It may be remarked that the question of producing alcohol from the prickly pear has been carefully studied in Australia; the conclusion drawn, however, was unfavourable. Analysis showed that the total sugar content of the most common Australian species, *Opuntia inermis*, was only 0·6 per cent., and the highest amount of sugar in any of the species examined was but 2 per cent. Distillation experiments yielded alcohol equivalent to only 0·5 per cent. of the weight of the plant used, so that the manufacture was considered unprofitable, and, indeed, scarcely practicable. But the South African prickly pear is said to be much richer in sugar than the Australian product, and this, of course, may make all the difference between success and failure in utilising the plant.

IN the Transactions of the Institution of Engineers and Shipbuilders in Scotland for December last there is published an interesting paper by Mr. W. B. Hird on "Electrical Ship Propulsion." The relative advantages of the various electrical methods of driving the propeller shaft are given, and also the results of trials on ships with electrical gearing. To illustrate the flexibility of the electric drive the author quotes the

claims made for the equipment of the American battle-cruisers. They are designed for a speed of thirty-five knots, and require 180,000 h.p. to be delivered to four propellers running at 250 revolutions per minute. Supposing that one motor out of the eight breaks down, it can be instantly disconnected, and the loss in total power being only one-eighth, the speed would only be reduced by about one knot. For cruising speeds the ship will attain twenty-six knots with only two generating sets and four motors at work, and nineteen knots with one generating set only and four motors in use. At full power the efficiency claimed is 93 per cent. On the other hand, it was pointed out that the electric gear was considerably heavier than the mechanical gear, and its efficiency is about 2 per cent. lower. The author considers that there were spheres of usefulness for both the "geared turbine" and the "turbo-electric system," and that in some cases they might with advantage be used in combination.

Sir Dugald Clerk read a paper on "The Distribution of Heat, Light, and Motive Power by Gas and Electricity" to the Royal Society of Arts on March 19. He takes as his basis of comparison for heating the amount of fuel consumed per thermal unit available in the gas or electricity, for lighting the amount of fuel consumed per candle-hour, and for motive power the horse-power-hours available per pound of fuel. From the point of view of coal conservation, he concludes that gas-heating should be used. Judging on this basis, there is little to choose between gas and electric lighting, but he is strongly in favour of gas motive power. Sir Dugald Clerk points out that of the coal-gas consumed in the United Kingdom probably 55 per cent. is used for heating, 35 per cent. for lighting, and 10 per cent. for motive power. He calculates that if electricity were used for these purposes 92 per cent. more heat units would be consumed. He concludes that, even assuming that the success of the super-electric stations so much discussed at present were assured, yet a gas service from a coal conservation point of view would be twice as economical. As regards thermal efficiency, this may be taken as correct, but it is unduly disparaging to the super-electric stations. The establishment of these stations would undoubtedly effect immense economies by abolishing many of the present wasteful electrical stations. Electricity was very largely used for driving the machinery upon which the winning of the war depended. It is difficult to believe that gas-engines would have been so successful. The rapidly extending use of electricity for cooking proves that more items than the thermal efficiency have to be taken into account before a just comparison can be made.

Sir Robert Hadfield has sent us a translation of a recent statement by M. Honoré giving some account of the French Steel and Iron Masters' Association. It appears from this that in recent years French ferro-metallurgy has shown a pronounced tendency towards concentration of effort. From 383 in 1875 the number of works dropped to 208 in 1912, while the total iron and steel production increased from 900,000 to 4,900,000 tons. Whereas, therefore, the capacity of the works averaged 2350 tons in 1875, it had been raised to 21,700 tons in 1912. As the works grew fewer in number, but individually stronger, they were led, by reasons of transport, supplies, etc., to group themselves in regions favourable to production. In 1875 pig-iron was manufactured in fifty-seven departments; in 1912 four-fifths of the pig-iron and three-fourths of the steel production had been concentrated in two departments, Meurthe-et-Moselle and Nord. The Steel and Iron Masters' Association dates from 1864. After twenty years it became the Employers' Federation of Iron Masters, the exclusive object of which was the study and defence of the economic, industrial, and commercial interests of the ferro-metallurgical industry. In 1914 the association numbered 252 adherents, representing 97 per cent. of the French production of pig-iron and 93 per cent. of steel. The total capital involved was 1150 million francs, and the number of workmen employed about 200,000, who in 1912 received 400,000,000 francs.

In a lecture on "The Sudd Reservoir," delivered at a meeting of the Institute of Egypt at Cairo on February 17, Sir William Willcocks reaffirms the claim that the problem of reservoir storage in the Nile Valley for irrigation purposes has been solved by Mr. John Wells and himself in their report on the sudd region of the White Nile. In support of his contention he adduces certain figures to show that, under the conditions prevailing in the Lower Nile, there is a shortage of 6 milliards of cubic metres of water out of the $13\frac{1}{2}$ milliards required annually for cultivation purposes in Egypt. This is after deducting 2 milliards as the capacity of the Aswan Reservoir as it stands. Sir William estimates that the 6 milliards deficiency can be made good from the natural storage supplies in the sudd region at a cost of about 6,000,000*l.*(E.). He also advocates the entire reconstruction of the Aswan Dam at a cost of 3,000,000*l.*(E.), on the ground that the present dam is not high enough and possesses "serious defects and shortcomings." The sudd region has, of course, long been regarded as an unfortunate blemish on the White Nile, both as regards navigation and drainage. It is covered with a dense mass of decayed vegetation, papyrus roots, reeds, and grasses, resembling peat almost in its consistency, and offering an obstruction which on more than one occasion has had to be cut through for something like fifty miles in order to obtain a passage for boats. Sir William characterises it as one of the most wonderful reservoirs in the world. "A score of milliards of cubic metres of water stand well above the level of the flat plain as though they were congealed. It is a veritable glacier at the head of the White Nile, and feeds it as the Himalayan glaciers feed the Ganges."

One of the most interesting ships added to the Navy during the war was the seaplane-carrying ship *Argus*, built by Messrs. William Beardmore and Co., Ltd., at Dalmuir. A fully illustrated account of this ship appears in *Engineering* for March 28. There is absolutely no obstruction on the flying-deck, not even funnels, and there is space under this deck for the accommodation and repair of seaplanes. She is, therefore, a floating hangar, the space given up for this purpose being 330 ft. long, 68 ft. wide overall, and 48 ft. clear, with a clear height of about 20 ft., and is of a capacity regarded as sufficient to accommodate twenty seaplanes. Hoists are provided from the hangar to the flying-deck, and cranes are available for lifting the seaplanes from the water on to the hangar-deck. The vessel was laid down originally as a first-class passenger and cargo steamer, and the Admiralty decided in 1916 to have her completed as a seaplane carrier. The navigating bridge, bridge-houses, wireless offices, etc., are placed forward under the flying-deck. The chart-house is capable of being raised above the flying-deck level or lowered to a stowing position under the flying-deck by hydraulic power, and when in a raised position commands a clear all-round view.

Mr. F. Edwards, 83 High Street, Marylebone, W.1, has just issued a Catalogue (No. 389) of upwards of nine hundred new and second-hand works dealing

with anthropology, folk-lore, archæology, and kindred subjects. Among the items listed we notice a batch of fifty-eight volumes of the Folk-lore Society's publications, comprising the *Folk Lore Record*, the *Folk Lore Journal*, *Folk Lore*, *County Folk Lore*, and "Extra Publications"; a complete set of the Psychical Research Society's Proceedings; Wright's "The English Dialect Dictionary," 6 vols.; Catlin's "North American Indian Portfolio" (coloured illustrations); long runs of the Journal of the Royal Anthropological Institute and of *Man*, and Reports 1 to 28 of the Bureau of American Ethnology. The catalogue is sent free upon application.

THE following are among the announcements of forthcoming books of science:—"The Environment of Vertebrate Life in the Late Paleozoic in North America: A Paleogeographic Study," E. C. Case (*Washington: Carnegie Institution of Washington*); "Psychoses of the War, including Neurasthenia and Shell Shock," Lt.-Col. H. C. Marr; "The Nervous Child," Dr. H. C. Cameron (*Henry Frowde and Hodder and Stoughton*).

OUR ASTRONOMICAL COLUMN.

JUPITER.—Observers of the surface of this planet have remarked that not for many years past has Jupiter presented so many interesting details as it has in the apparition that is now passing away. It has been noticed that the south equatorial belt has been unusually faint and its components extremely narrow, but it has gained redness in some parts, whilst the north equatorial belt has been losing its redness. This apparent transference of colour appears to be a periodic phenomenon. The feature known as the south tropical disturbance, first seen in 1901, the movement of which, especially with reference to that of the red spot, has been observed continuously since that time, became faint in the early months of this year, and in April this marking, together with the hollow in the south equatorial belt, in which the red spot lies, had quite disappeared, whilst the spot itself was seen only by some observers and in favourable circumstances.

NOVA AQUILÆ, 1918.—Observations of the nova of last year that have been already made in the morning sky show that the star is now fainter than sixth magnitude, for it has been estimated to be about 0·1 magnitude fainter than the neighbouring star B.D. +0·4027°, which appears as 6·26 in the Revised Harvard Photometry. A note from the Bergedorf (Hamburg) Observatory in the *Astronomische Nachrichten* of April 7 describes its spectrum about the date April 4 as consisting essentially of three bright lines in the red, yellow, and blue-green, and its appearance in the ordinary stellar eyepiece as a small reddish-yellow image covered by a bluish-green disc. The difference of focus gives a decided parallactic effect, looking slantwise, and the appearance is that of a double star with components of these colours.

"ANNUAIRE DE L'OBSERVATOIRE ROYAL DE BELGIQUE."—The volumes of this publication for the years 1915, 1916, 1917, and 1918 have lately been received. The first was printed and published in 1914 in the ordinary course, but the last three bear the date 1918 on the cover, and the preface to each is signed by M. Stroobant, Chief Astronomer of the observatory, *vice* the Director, the date of signing being 1918 November 11, the day of the armistice. These facts are significant, and the explanation is that the three books were printed in Brussels year by year without the knowledge of the occupying Power during the war, but were not issued because they would have had to be submitted to the enemy censor. The *Annuaire* for 1916, like the earlier volumes of the series, comprises what is practically a complete treatise on descriptive astronomy. There will be found in it definitions, descriptions, tables, photographs of nebulæ, comets, and star clusters, and a history of the recent progress of astronomy. The later volumes are less complete, and much of the information about the current events of astronomy had to be omitted because astronomical publications did not reach Belgium during the war. M. Stroobant, who is to be congratulated on carrying on in such unusual and painful circumstances, is responsible for the preparation, because M. Lecointe, the Director of the Royal Observatory, has been serving in the Belgian Army. It is worthy of remark that Greenwich civil time, which is the official time of the country, is used throughout, and this doubtless was one reason for keeping these volumes from the eyes of the enemy. The preface to the edition for the current year, 1919, which was signed on 1918 November 18, contains the pleasing announcement that, as the country is now liberated, the *Annuaire* will be able to appear in the future unfettered.

SCIENCE AND THE CLASSICS.

THE Classical Association held its annual meeting at Oxford on May 16–17, and Sir William Osler delivered the presidential address on "The Old Humanity and the New Science." Sir William began by referring to the history of the Divinity School, in which the meeting was held. It had been frequented, he said, by Linacre, who, in addition to being a pioneer in medical education, had achieved a great reputation as a scholar. It had known the times when the natural sciences were so much neglected that the belief was solemnly maintained that fossils had been buried in the earth to test man's belief in the omnipotence of the Creator. The last century had witnessed extraordinary developments in scientific knowledge of every sort, and the interest taken in discovery on one hand, and social progress on the other, had rather thrown the old humanities into the background. It might be maintained, from the part played by Science during the war, that its chief result had been to add to the sum of human misery; but, all things considered, such utilisation of discovery could not be fairly used as a reproach against Science; the fault lay in the degradation of the human mind which the horrors of the last five years had brought about. Sir William was rather inclined to subscribe to the opinion that the invention of firearms had been one of the main causes which saved the human race from destruction. But to assure the continued well-being of the race a different kind of education was necessary. The solution of the difficulty would be found in the union of Science with the Humanities. Germany, in which scientific education had been systematically developed, nevertheless had paid far greater attention to the study of the classics than any other modern nation.

The attitude of our modern society towards classical education might be compared with that of ants and wasps, which protect their larvæ, but require from them a return in the form of a honey which they secrete; and if the larvæ do not exude it freely, the V.A.D. wasps will nip their patients' heads to cause a quicker flow. The academic larvæ of to-day were much to blame, and it was for them to see to it that they exude their nectar more willingly. There had been practically no change in the papers set for "Greats" between 1831 and 1919; and, indeed, in 1267 the teaching of the schools was very much as it

is now. Classical education bulked too large in the University, and the unequal distribution gave cause for just resentment. Though biology provided a parallel in the destruction of millions of eggs in order to produce one salmon, and though the Oxford system occasionally produced a man like Ingram Bywater, the feelings and the lost opportunities of the countless others who were destroyed in the process ought to be considered. It would be far better for the average man to infect him with the spirit of the humanities than to waste his time by too much laborious attention to grammatical detail.

The great philosophers of old—Hippocrates, Galen, Theophrastus, Hero, Aristarchus, and others—fertilised Science and went far on the way towards understanding the system of Nature, but in the Middle Ages the thread was broken; Roger Bacon was the only medieval student with a modern outlook, and the loss of connection with the Humanities was a serious set-back to Science.

Modern men of science might well read such books as Lucretius's "De Rerum Natura," in which a great deal of modern discovery had been foreshadowed; and scholars should not hesitate to point this out.

An attempt was being made at Oxford to start a new Honours School of Philosophy in relation to science. This should prevent scientific men from getting lost in the backwaters of premature research. The groundwork of this school should not be limited to modern ideas, but the continuity of the history of Science through all the ages should be grasped. There was a great need of both general and individual reconstruction, and this should be undertaken in the spirit of Hippocrates's maxim, ἢν γὰρ παρῇ φιλανθρωπίη, πάρεστι καὶ φιλοτεχνίη—"The love of humanity is the basis of the love of science."

Loan Exhibition of Early Scientific Instruments.

On May 16 Sir William Osler opened a loan exhibition of most remarkable instruments and manuscripts illustrating the scientific history of Oxford from the fourteenth to the eighteenth century. The greater part of the instruments now shown have never been publicly exhibited before. They have been unearthed in cupboards and corners of libraries of colleges and university departments. They are, for the most part, in their original state and of corresponding historic value.

The two earliest dated Persian and Moorish astrolabes, A.D. 987 and A.D. 1067, lent by Mr. Lewis Evans, form a worthy introduction to a wonderful series of instruments lent by Merton College. One of these is traditionally associated with Chaucer, and another of the Saphea type is considered by Mr. Gunther to have been the instrument left by Simon Bredon either to the college or to its great astronomer, Rede, early in the fourteenth century. The energies of these early astronomers were largely directed to the preparation of astronomical tables, which had a wide circulation, and Oxford was regarded very much as Greenwich is now.

The later astronomical exhibits illustrate the instrumental equipment of the Earl of Orrery, who must have been acquainted with the first members of the Royal Society. Many of his instruments are still in the state in which he left them to Christ Church. His telescopes of 8 ft., 9 ft., and 12 ft. focal length, with many-draw vellum tubes and lignum vitæ lens-mounts by Marshall and Wilson, form a unique series.

There is also a Marshall microscope of 1693 in excellent condition, as well as some magnificent planetaria and other astronomical models by Rowley, the maker of the original orrery.

The slide-rule of 1654 in the South Kensington Museum, described in NATURE of March 5, 1914, by Mr. Baxandall as the earliest known slide-rule, must now yield to an instrument lent by St. John's College, dated 1635. It is in the form of a brass disc 1 ft. 6 in. in diameter engraved with Oughtred's circles of proportion. Would space permit, the series of volvelles or calculating discs showing the age of the moon from manuscripts of the fourteenth and fifteenth centuries, and some early surveying instruments, are worthy of more particular description, as well as many other treasures now shown to the public for the first time. A printed catalogue of the principal exhibits, prepared by Mr. R. Gunther, of Magdalen College, is published by the Clarendon Press, price 1s.

ELECTRIC FURNACES.

THE importance of electro-metallurgy at the present time was made evident at the joint meeting of the Institution of Electrical Engineers and the Iron and Steel Institute on May 8, when six papers were read on electric furnaces. The descriptions given by the various authors related almost exclusively to furnaces suitable for the iron and steel industry, of which there are at present 117 at work in this country, as compared with 287 in the United States and 43 in Canada. The nominal output of the British furnaces was given by Mr. R. G. Mercer as 31,250 tons per month, but, owing to various causes, the actual production was only about 65 per cent. of this amount. It will be seen from these figures that electric steel is now a well-established commercial product, and with the advent of cheaper electric power large developments may be witnessed.

The features common to all electric steel furnaces are (1) the use of alternating current with suitable transformers and (2) the formation of an arc between carbon electrodes above the charge, which plays upon the slag on the surface. It is customary to place one or more electrodes beneath the hearth of the furnace, so that a part of the current may flow through the charge when the hearth becomes hot enough to act as a conductor, the mixing of the molten metal being thereby facilitated. The electrical connections vary according to whether single-, two-, or three-phase current is employed, it being necessary in all cases to obtain a balanced polyphase load on the service lines.

In the two-phase furnace described by Mr. W. K. Booth two main electrodes are used, together with an auxiliary electrode which, at starting, is embedded in the charge, and serves to draw the arc between the charge and the main electrodes. Two other electrodes are located in the hearth, which, when hot, permits current to flow crosswise from these electrodes through the metal to the main electrodes, the auxiliary then being withdrawn. In Sahlin's furnace the electrodes enter at the sides, forming pairs inclined at an angle, the resulting arc being then directed on to the surface of the charge, several pairs, suitably connected, being used in the larger types. A single electrode is placed beneath the hearth. In the furnaces described by Mr. Victor Stobie vertical electrodes are used, the number depending on the size of the hearth, and the distribution being such as to ensure the heating of the whole surface of the charge. The hearth electrodes are stated by Mr. Stobie to be undesirable in large furnaces, though essential in small ones. A special feature of Stobie furnaces is a device for sealing the entrance of the electrode to the furnace, whereby oxidation at this point is prevented. The special electrical connections for obtaining a balanced load constitute the characteristic features of the furnaces dealt with by Mr. J. Bibby and Mr. H. A. Greaves, the former of whom gave

an interesting account of the design of electric reduction furnaces for the production of pig-iron from ore, a process which becomes economically sound when 1 horse-power-year of electrical energy does not cost more than 2·3 tons of coke, and is now coming into extensive use in Sweden and elsewhere. In this country steel refining for ingots and castings and the production of ferro-manganese and steel alloys constitute the chief uses of electric furnaces at present.

The relative merits of amorphous carbon and graphite for electrodes were dealt with in several of the papers read, the balance of evidence being in favour of graphite, which, owing to its superior conductivity, permits of the use of narrower electrodes. Dolomite is generally used to form the hearth, but acid linings are said also to be employed in some cases. In spite of the higher cost of heat produced electrically over the use of fuel, the superior quality of the products, the small wastage by oxidation, and the ease with which scrap may be utilised justify the use of the electric furnace. It is to be hoped that the experience gained with steel will lead to the production of artificial abrasives such as carborundum and alundum in Britain, and also to the development of the higher refractories needed in many metallurgical processes. CHAS. R. DARLING.

BRITISH OPTICAL RESEARCH.

WE have before us several books and a large number of reprints from various scientific publications, all of which represent work done by members of the scientific staff of Messrs. Adam Hilger, Ltd., since the beginning of the war. We must welcome not only the fact that a British optical firm has realised the value of a considerable staff of highly qualified scientific collaborators, but more particularly the circumstance that this staff is encouraged by the firm in the *publication* of its work, and in thus helping to hasten the recovery by this country of the leading position in applied optics which it undoubtedly held in a rather distant past, but which it had almost completely lost in more recent years, largely through the narrow outlook of a majority of optical firms in seeking only immediate and certain profit and keeping down or totally excluding "non-productive" labour, but also through the failure of our educational institutions to teach real optics capable of application to actual technical problems instead of the transparent sham beloved by examiners and their text-books.

From the practical optician's point of view the most valuable of the publications are probably those by Mr. Twyman, the present head of the firm, which deal with the Hilger interferometer for the correction of lenses and prisms (*Phil. Mag.*, January, 1918, and *Photogr. Journ.*, November, 1918). By directly indicating the residual imperfections of a lens or prism in the form of a contour-map built up of interference-fringes, this instrument enables a skilled workman systematically to remove those imperfections and to perform, without other guidance, the process of "figuring" which hitherto had to be directed by a highly skilled and experienced observer on the basis of repeated tests of the lens or prism by the in- and out-of-focus appearance of a real or artificial star, and which then was an expensive, slow, and uncertain operation. For the present this valuable method is, unfortunately, limited to small sizes owing to the cost and difficulty of producing large plano-parallel plates of the requisite almost absolute perfection.

Mr. Twyman also contributes an instructive paper on the annealing of glass (Trans. Soc. of Glass Technol., vol. i., 1917), which deals more especially with the importance of passing the glass very slowly through a comparatively short range of temperature. In describing methods of fixing this range, and in working out the law according to which the viscosity of the glass increases within the critical range, Mr. Twyman goes decidedly beyond the publications of the Jena works on this subject of "fine annealing."

Two members of the staff, Mr. R. G. Parker and Mr. A. J. Dalladay, describe another valuable innovation in optical precision work, viz. the permanent union of very closely fitting polished glass surfaces by raising them to a very closely gauged temperature at which they become welded together without any distortion which would affect their optical perfection (Trans. Faraday Society, vol. xii., part 1, 1916). In the case of glasses which agree sufficiently closely in their rate of expansion, this promises to prove a very decided improvement on the usual cementing processes.

In an interesting paper to the Physical Society (Proc., vol. xxx., part iii.) Mr. Simeon discusses the accuracy attainable with critical angle refractometers. As is probably widely known, these instruments are now built by Messrs. Hilger, Ltd.

Dr. L. Silberstein, the scientific adviser of the firm, is widely known as an extremely able mathematical physicist. His two books on "The Electromagnetic Theory of Light" and on "A Simplified Method of Tracing Rays" have already been reviewed in these columns. In the collected researches before us we find five additional contributions from his pen to the *Phil. Mag.* A paper on "Fluorescent Vapours and their Magneto-optic Properties" and two on "Molecular Refractivity and Atomic Interaction" are purely theoretical investigations on subjects only remotely connected with technical optics. In a paper on "Multiple Reflections" (November, 1916) Dr. Silberstein gives a very general treatment, by his favourite vectorial method, of the reflection of light at combinations of plane mirrors, more particularly with the view of elucidating the behaviour of the important "central" or "corner-cube" mirrors which have proved so valuable for signalling and range-finding purposes. Finally, there is a paper on "Light Distribution round the Focus of a Lens at Various Apertures" (January, 1918), in which the problem of the spurious disc in the presence of spherical aberration is attacked. One would like to see the subject worked out in a more practically useful form; the example of the phenomena at the paraxial focus of a plano-convex lens which is chosen for numerical treatment is not very interesting, and there is an obvious numerical error in the working out of the "best relative aperture" on p. 47. By the author's own formula (20) this comes out at rather more than twice the stated values, and the results then agree fairly well with everyday experience as to the permissible aperture of plano-convex lenses as used in ordinary eyepieces and magnifiers. But, apart from this little slip, the matter of real interest to optical designers is the appearance of the image at the point of best concentration of the light, which is easily shown to lie very nearly midway between the geometrical foci of the paraxial and marginal rays respectively, for in this position the maximum difference of phase is only one-fourth of that at either the paraxial or the marginal focus. At the correctly worked out "best relative aperature" the lens of 5·56 cm. radius of curvature chiefly calculated for by Dr. Silberstein has a longitudinal spherical aberration of about 0·6 mm., and the interesting region would therefore be found about 0·3 mm., say 600 λ. from the paraxial focus. It is, therefore, not surprising that the author finds no appreciable change in the light distribution on trying a change of focus of "even" 10 λ. It is greatly

to be hoped that this valuable work will be further developed, as it deals with a matter of the highest importance and interest.

We have finally to notice a most useful reference-book, "Tables of Refractive Indices," vol. i., "Essential Oils," compiled by R. Kanthack, which has just been published by the firm. A glance at the introductory list of 282 references to the widely scattered literature drawn upon in this compilation is alone sufficient to emphasise the value of the little volume.

We shall look forward with great interest to further additions to this first list of the achievements of the scientific staff of Messrs. Adam Hilger, Ltd.

A. E. C.

A NEW BRITISH WHALE.

Dr. S. F. Harmer's report on Cetacea stranded on the British coasts during 1918, published by the British Museum (Natural History), is one of quite exceptional interest to cetologists. Its most important feature is the announcement of the stranding during 1917 of a specimen of the remarkably rare True's whale (*Mesoplodon mirus*). In his report for 1918 this whale was recorded as Cuvier's beaked whale (*Ziphius cavirostris*) from Liscannor, Co. Clare. This was a quite pardonable error, since the skeleton reached the museum in a roughly cleaned condition, and displaying two large terminal mandibular incisors closely similar to those of a Ziphius. When the cleaned skull came to be examined, however, it became evident that a mistake had been made. This is the only male which has yet been recorded, and, so far, but three examples of this animal are known. The first recorded specimen, a female, was taken at Beaufort Harbour, North Carolina, on July 26, 1912, and was described by the late Mr. F. W. True. It now appears that a third example is in the possession of the Galway Museum. This was taken in Galway Bay somewhere about 1899. Some very useful measurements of the skull, a photograph of the mandible, and comparisons between the teeth of the Liscannor specimen and those of other species of Mesoplodon and Ziphius, add greatly to the value of this account. The mandible of Berardius, it may be remembered, bears two pairs of teeth, a pair at the extreme end of the mandible and a pair further back. Dr. Harmer suggests, and he is probably right, that the teeth of Ziphius, *Mesoplodon mirus*, and *M. hectori* answer to the anterior pair, while those of *Mesoplodon bidens* and allied species are homologous with the posterior pair.

Since each succeeding report adds greatly to the value of those which have preceded it, we trust that these annual summaries will long be continued, for they will add immensely to our knowledge of the migrations of the Cetacea of our seas. Already they show that some species are not so rare as they were supposed to be until this investigation was embarked upon.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Edinburgh.—A lectureship on the subject of organisation of industry and commerce is to be instituted, the endowment fund having been supplied by subscriptions from members of the following bodies:—Edinburgh Chamber of Commerce, Edinburgh Merchant Company, Leith Chamber of Commerce, Leith Shipowners' Society, and the Institute of Bankers in Scotland.

Prof. Pringle Pattison has intimated his resignation as from September 30 next of the chair of logic and metaphysics.

Oxford.—Several professorships which have been suspended during the war have now been restored by decree of Convocation. Among these are the professorships of logic, geometry, and experimental philosophy. An election to the latter has already taken place, as previously recorded in Nature.

The preamble of a statute admitting women as candidates for diplomas in science and other subjects has recently been passed by Congregation.

On May 20 the same body accepted the preamble of a statute introducing many changes in the First Public Examination (commonly known as "Moderations"). Among these is the incorporation as optional subjects in this examination of mechanics and physics, chemistry, zoology, and botany.

The *Times* announces that the sum of 200,000*l.* is being provided by the Victorian Government to enable Melbourne University to complete its buildings.

Applications for the filling of the chair of biology in the University of Melbourne, consequent upon the retirement of Sir W. Baldwin Spencer, are invited by the Agent-General for Victoria, Melbourne Place, Strand, W.C.2. The duties of the new professor will begin in March, 1920.

A Wireless Press message from New York states that Harvard University has raised a fund of 8000*l.* to found a scholarship, to be known as the Choate memorial scholarship, which will provide for the exchange of students between the American university and Cambridge.

A limited number of free places tenable at the Imperial College of Science and Technology, South Kensington, are being offered by the London County Council to students capable of profiting by an advanced course of instruction. Applications have to be made upon special forms, obtainable from the Education Officer, L.C.C., Victoria Embankment, W.C.2, and returned by Saturday, June 14.

The University Court of the University of Aberdeen will in July, under the Georgina McRobert foundation, appoint a lecturer in pathology, with special reference to malignant disease. The lecturer should possess special knowledge of pathological chemistry, and will be expected to conduct research and to give instruction in subjects connected with his investigations. Applications for the post must be received on or before June 24.

The regulations respecting the open competitive examinations (August, 1921) for clerkships (Class I.) in the Home Civil Service have now been published by the Civil Service Commission. The examination will be in two parts. The papers in Section A, which must be taken by all candidates, are:—Essay, English, questions on contemporary subjects, science, translation from one language. These all carry equal marks. In addition, there is a *viva-voce* examination which is valued as equal to three of the foregoing. In Section B a very wide choice of subjects is offered. In this there seems to be a fair balance, and ample opportunity is offered to students of mathematics or science. It is interesting to compare these regulations with the recommendations of Sir J. J. Thomson's Committee. They do not, for instance, require "all candidates to supply evidence of a continuous course of training in science extending over several years." They do offer some encouragement towards the study of the subject, though the extent of this will depend on two factors: reasonable opportunity for the student of science in the essay paper, and the appointment of a representative of science among the *viva-voce*

examiners. The Thomson Committee recommended: "That many permanent posts can best be filled by men selected, not by the ordinary competitive examination, but at a riper age on the ground of high scientific qualifications and professional experience." It is to be hoped that this point will not be overlooked; it is of paramount importance to the Empire.

THE Education Section of the British Association has prepared a full programme for the meeting to be held at Bournemouth. On Tuesday, September 9, Sir Napier Shaw will deliver his presidential address at 10 o'clock, the latter part of the morning being devoted to the consideration of the free-place system, with especial reference to the question of maintenance grants and the tenure of the free-place holders. In the afternoon a discussion upon the teaching of English will take place. On Wednesday, September 10, the morning will be devoted to considering "The Method and Substance of Science Teaching"; several well-known educationists have promised to take part in the discussion, and an interesting debate is expected upon the two reports recently issued by Sir Joseph Thomson's and Sir Richard Gregory's committees. During the Wednesday afternoon a joint meeting with Section F (Economics) will consider the question of "Education in Relation to Business." The future of continuation schools is to be discussed on the Thursday morning, and, in view of the changes which the new Education Act will cause in these, this should prove one of the most interesting features of the meeting; for Thursday afternoon an animated debate upon the relation of humanistic and scientific studies is being arranged. It is hoped that Bishop Welldon will be able to open a discussion upon "Training in Citizenship" on the Friday morning; and in the afternoon of that day the question of private schools will be considered, the latter subject being one of especial interest in towns like Bournemouth. Communications intended for the section should be addressed to the Recorder, Mr. Douglas Berridge, the College, Malvern.

UNIVERSITY Bulletin No. 19 of the University of Illinois is devoted to a pictorial description of buildings, laboratories, and other facilities for instruction and research at the College of Engineering and Engineering Experiment Station of the University. The work of the college includes twelve four-year courses leading to degrees. The feature in which the institution differs most from European practice is the experiment station, an organisation created in 1903 to stimulate engineering education and to promote the investigation of practical problems. Its control is vested in a director, the heads of the departments of the college of engineering, and the professor of industrial chemistry. The researches are chiefly conducted by full-time research assistants, research graduate students, and special investigators engaged for a limited time on single problems. The University maintains fourteen graduate studentships for research, and two have been founded by the Illinois Gas Association. Each carries a stipend of 500 dollars and freedom from fees, and leads to a degree of M.Sc. Half the time of these students is devoted to research, and the remainder is available for study. The station has published 110 bulletins and eight circulars, mainly distributed free. In this pamphlet interesting photographs are given of the buildings, laboratories, libraries, testing machines, mining machinery, arrangement for testing locomotives, electric railway test car, and training quarters for the cadet corps. A department not usually found in engineering colleges, at any rate in so comprehensive a form, is that of ceramic engineering. It deals with the technology of industries concerned with clay, glass, cement, lime, gypsum, and enamelled ware.

IT is satisfactory to observe that serious efforts are being made to provide for the soldiers belonging to the Army of Occupation in Germany reasonable educational facilities—general, scientific, and technical. It is extremely important that men so situated, with probably much leisure time at their disposal, should have opportunities of pursuing their studies and of continuing the experience they have already gained in their former avocations, and even of taking up some new pursuit, where they have the initial gift of artistic expression, so that when they return to civil life they may readily find openings for effective employment. In a recent issue of the *Cologne Post*, a daily paper published in English for the Army of the Rhine, attention is directed to the establishment in the Handels Realschule in Cologne of academic and commercial courses with a wide range of subjects, and to the Army Technical College which it is proposed to open in a well-equipped factory at Siegburg, where arrangements are made by which the apprentice or improver can continue the practice of his vocation; where also men and officers of artistic aptitudes can take up specific arts and crafts; and where men of satisfactory education can pursue their studies so as to qualify them for degrees in engineering or cognate subjects. Stress is laid upon due preparation for such courses and the great value of scientific direction, so that workers shall know not only what to do, but also why they do it. Mere empiricism is discouraged, and a thorough grounding in the science of technical pursuits made a matter of chief moment. There is, moreover, already a science college at Bonn where any soldier desirous of taking up agricultural pursuits can enter upon the study of the science of agriculture and the allied sciences.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, March 28.—Prof. C. H. Lees, president, in the chair.—Sir Richard **Glazebrook**: Metrology in the industries. In opening this discussion Sir Richard Glazebrook traced briefly the early history of metrology. The first application of really accurate measurement to mechanical engineering was chiefly due to Sir Joseph Whitworth, who taught people to make their length measurements with great accuracy and introduced reference gauges. The next step was the use of limit gauges. This greatly simplified the gauging of repetition work. At the time of the Boer War the supplies of ammunition, especially breech plugs of guns, were not interchangeable as obtained from different shops. This led to the formation of the Engineering Standards Committee on Gauges, which tackled the problem of producing accurate gauges with defined limits and tolerance, and by 1914 a certain number of firms had introduced the use of limit gauges. In 1915 the demand for munitions on a great scale brought home the great importance of interchangeability and the need for strict standardisation of gauges. When screw gauges were first tested at the National Physical Laboratory the rejections totalled 75 to 80 per cent.; but after two years this was reduced to about 20 per cent. Now, if we are to maintain our position in peace, the maintenance of interchangeability in engineering manufacture is equally necessary, so that we may manufacture in quantity. Much has yet to be done if we are to keep ahead, and the co-ordination of research with routine testing is vital to the progress of the science.

Aristotelian Society, April 15.—Prof. G. D. Hicks in the chair.—Prof. J. B. **Baillie**: The stereoscopic character of knowledge. In knowledge the mind seeks to become conscious of the individuality of the object in its solid integrity. In the process of knowledge the whole energy of the individual mind is engaged, and not simply one particular function. The ultimate achievement of knowledge is the fulfilment or realisation of the individual mind as a single whole of individuality existing and subsisting in interdependence with a world of equally real individual beings. The view of knowledge as consisting in a mere linear succession of stages which are means to and subordinate to an end is set aside as inaccurate because the end is present in the process from first to last, and because the life of the mind, of which knowing is one mode, grows and maintains itself by the simultaneous co-operation of all its functions in their inseparable unity. Equally inaccurate, it is held, is the view that in knowledge the mind merely represents, reproduces, and copies the real world. As contrasted with these views, it is maintained that knowledge is stereoscopic or realistic in character. It is realistic in the sense that it presents the real in its solid integrity, that it is a vital activity in which the individual mind fulfils its own life, and that it is the consummation in conscious form of the nature of the real world as embodied in man's plane of existence.

Challenger Society, April 30.—Prof. E. W. MacBride in the chair.—E. J. **Allen**: A contribution to the quantitative study of plankton. To determine the number of individual organisms belonging to the smaller Protista which are present in a sample of sea-water, the best method hitherto available has been to subject a small sample of the water to the action of a centrifuge, and then count under the microscope the number of individual cells contained in the deposit. By adding a small quantity ($\frac{1}{2}$ c.c.) of the sample of sea-water to be examined to a large quantity ($1\frac{1}{2}$ litres) of a suitable sterile culture medium, subdividing into a number (70) of small flasks, and allowing the organisms in these flasks to develop, the author has shown that a very much larger number of unicellular organisms are present than the centrifuge method would lead one to suppose.

Geological Society, May 7.—Mr. G. W. Lamplugh, president, in the chair.—Major R. W. **Brock**: Geology of Palestine. The following formations are recognised:—

QUATERNARY.	Alluvium.	Dunes; Valley and Plains clay, and Silt; Desert Crust.		Heavy volcanic flows, basalts, ashes, tuffs, etc.
	Diluvium.	Terrestrial.	Lisan Formation (Jordan-lake-beds).	
		Marine.	Upper Calcareous Sandstone and Limestone.	
			Lower Calcareous Sandstone.	
TERTIARY.	Pliocene.	Lacustrine.		
	Eocene.	Nummulitic Limestone.		
MESOZOIC.	Cretaceous.	Upper	Senonian: Danian, Campanian, Santonian	volcanics, basalts.
			Turonian	
			Cenomanian.	
		Lower	Nubian Sandstone.	
			Jebel-Usdum formation (?).	
	Jurassic.	On Lebanon and Hermon only.		
PALÆOZOIC.	Carboniferous.	Possibly south-east of the Dead Sea.		
	Cambrian.	Dolomite and sandstone.		
PRE-CAMBRIAN.	Volcanics and arkose.			
	Red granites and porphyries.			
	Grey granites, gneiss, and crystalline schists.			

The structure was shown to be that of a tableland bisected by a great rift-valley (graben), and flanked by a coastal plain. A section was exhibited illustrating East Jordanland acting as a horst; the boundary faults of the Jordan Trench; the unequal sinking of the contained blocks; the western section of the tableland sunken with relation to the eastern, and thrown into an asymmetric anticline, the limbs of which rise in steps through monoclinal flexures or faults.

Optical Society, May 8.—Prof. F. J. **Cheshire**: The polarisation of light. The lecture was illustrated throughout by means of projection apparatus invented and designed by the lecturer, an important feature of the apparatus being the form of polariser in which a modified double-image prism was employed instead of the usual Nicol. It was explained that the spar required for this particular prism was only about one-eighth of that required for a Nicol prism of the same aperture.—J. **Rheinberg**: Graticules. Starting with the origin of the term graticules, which are defined as the "measuring scales or marks placed in the focal plane of an optical instrument for the purpose of determining the size, distance, direction, position, or numbers of the object viewed coincidently with the scale itself," the paper discusses in detail the various methods of manufacture in this country and abroad up to the period of the war, which led to the Germans having a practical monopoly of the article except in the case of simple patterns, such as cross-lines and simple patterns without numerals. This is followed by some account of the research work done during the war, which led to the production of graticules by the author, first by grainless photography, and ultimately by filmless photography, enabling graticules to be turned out in large quantities, not only of the kinds hitherto only produced abroad, but also of many new kinds. The optical peculiarities of the various kinds are next discussed, and a chapter deals with graticule design, showing how, with the variety and choice now available, it is necessary to co-ordinate the graticule to the design of the optical instrument and its purpose as a whole. A number of new uses for graticules are put forward, and it is suggested that new applications, some of which have already been initiated, might easily lead to important improvements in many types of optical apparatus.

Zoological Society, May 13.—Prof. E. W. MacBride, vice-president, in the chair.—N. **Taylor**: A unique case of asymmetrical duplicity in the chick.—Lt.-Col. S. Monckton **Copeman**: Experiments on sex determination.

Mathematical Society, May 15.—Mr. J. E. Campbell, president, in the chair.—Prof. G. N. **Watson**: The zeroes of Lommel's polynomials.—Prof. W. H. **Young**: The triangulation method of defining the area of a surface.

MANCHESTER.

Literary and Philosophical Society, April 29.—Prof. G. Elliot Smith, president, in the chair.—Sir Henry **Miers**: Some features in the growth of crystals. Crystals not only change their form during growth by the development of new faces, but also often display a tendency to appear first as needles and then in regular forms, seeming to pass through two stages. Experiments were made by the author many years ago in an attempt to determine the concentration of the solution in contact with a growing crystal, the refractive index being measured by the method of total internal reflection. These experiments led to the conclusion that in a cooling supersaturated solution stirred in an open trough, a sudden change in refractive index takes place at a definite temperature, and that this is due to the sudden appearance of new crystals or to the suddenly increased growth of the crystals already present. Enclosed in a sealed tube and shaken, the solution yields a shower of crystals at this temperature alone, although, for example, in the case of sodium nitrate, it is about 10° below that of saturation. Further experiments on a large

number of aqueous solutions and binary mixtures, such as salol mixed with betol, confirmed the conclusion that a supersaturated solution passes at a definite temperature into a condition (the labile state) in which spontaneous crystallisation can be induced by mechanical means, whereas above this temperature (the metastable state) crystals only grow by inoculation of the solution with crystalline germs.

BOOKS RECEIVED.

Cultural Reality. By Dr. F. Znaniecki. Pp. xv+359. (Chicago: University of Chicago Press.) 2.50 dollars net.

Le Français Enseigné par la Méthode Intuitive et Directe. By Prof. P. Dessagnes. Pp. viii+304. (Paris: Masson et Cie.) 5 francs net.

A Manual of Machine Design. By F. Castle. Pp. ix+351. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*.

The Principles Underlying Radio-Communication. (Radio Pamphlet No. 40, December 10, 1918, Signal Corps, U.S. Army.) Pp. 355. (Washington: Government Printing Office.)

Aquatic Microscopy for Beginners, or Common Objects from the Ponds and Ditches. By Dr. A. C. Stokes. Fourth edition. Pp. ix+324. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Fats and Fatty Degeneration. By Prof. M. H. Fischer and Dr. M. O. Hooker. Pp. ix+155. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 9*s*. 6*d*. net.

Shore Processes and Shoreline Development. By Prof. D. W. Johnson. Pp. xvii+584. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 23*s*. net.

Macmillan's Geographical Exercise Books. Africa. With questions by B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

Songs from a Watch-Tower. By R. H. McCartney. Pp. 151. (Chicago and New York: Fleming H. Revell Co.)

Fresh Hope and Health for Hospital Patients and Invalids. By C. Muller. Second edition. Pp. 63. (London: G. Bell and Sons, Ltd.) 2*s*. net.

Biochemical Catalysts in Life and Industry. Proteolytic Enzymes. By Prof. J. Effront. Translated by Prof. S. C. Prescott, assisted by C. S. Venable. Pp. xi+752. (London: G. Bell and Sons, Ltd.) 23*s*. net.

Fresh-water Biology. By Prof. H. B. Ward and G. C. Whipple and others. Pp. ix+1111. (London: G. Bell and Sons, Ltd.) 28*s*. net.

British Museum (Natural History). Studies on Acari. No. 1. The Genus Demodex, Owen. By S. Hirst. Pp. 44+xiii plates. (London: British Museum (Natural History); Longmans and Co., and others.) 10*s*.

A Course in Machine Drawing and Sketching. By J. H. Dale. Pp. vi+186. (London and Edinburgh: W. and R. Chambers, Ltd.) 3*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 22.

ROYAL INSTITUTION, at 3.—Prof. F. Keeble: Intensive Cultivation.

ROYAL SOCIETY, at 4.30.—Prof. W. J. Sollas: The Structure of Lysorophus as Exposed by Serial Sections.—O. Rosenbein: A Preliminary Study of the Energy Expenditure and Food Requirements of Women Workers.—M. Greenwood, C. Hodson, and A. E. Tebb: Report on the Metabolism of Female Munition Workers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. S. Chapman: Electrical Phenomena occurring in High Atmospheric Levels.

FRIDAY, MAY 23.

PHYSICAL SOCIETY, at 5.—Lewis F. Richardson: A Form of Knudsen's Vacuum Manometer.—Gilbert D. West: Theories of Thermal Transpiration.—Prof. W. H. Eccles: Demonstration of a Tuning-fork sustained by Thermionic Tubes.

SATURDAY, MAY 24.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

MONDAY, MAY 26.

ROYAL SOCIETY OF ARTS, at 4.30.—Capt. F. E. D. Acland: A New Prime Mover of High Efficiency and British Origin.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Capt. A. de C. Sowerby: Recent Journeys in Manchuria.

TUESDAY, MAY 27.

ROYAL INSTITUTION, at 3.—Prof. W. H. Bragg: Listening under Water.

ROYAL SOCIETY OF ARTS, at 4.30.—Lt.-Col. the Hon. Sir John McCall: Science and Industry in Australia.

ZOOLOGICAL SOCIETY, at 5.30.—J. T. Cunningham: Result of a Mendelian Experiment on Fowls, including the Production of a Pile Breed.—Miss Kathleen F. Lander: Some Points in the Anatomy of the Takin (*Budorcas taxicolor whitei*).—E. P. Allis: Certain Features of the Otic Region of the Chondrocranium of Lepidosteus, and Comparison with other Fishes and higher Vertebrates.

WEDNESDAY, MAY 28.

ROYAL SOCIETY OF ARTS, at 4.30.—H. J. Powell: Glass Making Before and During the War.

THURSDAY, MAY 29.

INSTITUTION OF ELECTRICAL ENGINEERS, at 2.30.—Annual General Meeting.

ROYAL INSTITUTION, at 3.—Sir Valentine Chirol: The Balkans.

ROYAL SOCIETY, at 4.30.—Croonian Lecture—Dr. H. H. Dale: The Biological Significance of Anaphylaxis.

ROYAL AERONAUTICAL SOCIETY, at 8.—Squadron-Commander G. M. Dyott: Flying in South America.

FRIDAY, MAY 30.

ROYAL INSTITUTION, at 5.30.—Sir John R. Bradford: A "Filter-passing Virus in Certain Diseases.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Discussion resumed by Dr. W. Rosenhain on Paper by Dr. W. H. Hatfield: The Mechanical Properties of Steel, with some consideration of the Question of Brittleness.

ILLUMINATING ENGINEERING SOCIETY, at 8.—F. W. Willcox: The Gas-filled Lamp and its Effect on Illuminating Engineering.

SATURDAY, MAY 31.

BRITISH PSYCHOLOGICAL SOCIETY, at 3.30.—F. E. Bartlett and Miss E. M. Smith: Listening to Sounds of Minimal Intensity.—E. Bullough: The Relations of Æsthetics to Psychology.

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THURSDAY, MAY 29, 1919.

NATURAL ORGANIC COLOURING MATTERS.

The Natural Organic Colouring Matters. By Prof. A. G. Perkin and Dr. A. E. Everest. (Monographs on Industrial Chemistry.) Pp. xxii+655. (London: Longmans, Green, and Co., 1918.) Price 28s. net.

THIS comprehensive treatise is the first English monograph to deal exhaustively with the fascinating but complex chemistry of the natural organic colouring matters. The historical aspect of the subject-matter and the scheme of classification are unfolded in the introduction, after which eighteen groups of natural dyes are described. The first chapter deals with the anthraquinone group, containing alizarin, the colour principle of madder root, which shares with indigo of the nitrogenous indole group the distinction of being one of the dyes of an antiquity so remote that it precedes the dawn of history. Although the importance of alizarin and its synthetic derivatives has overshadowed that of its other naturally occurring congeners, yet it should not be overlooked that the anthraquinone group contains also cochineal, a colour principle originally obtained from Mexico, and utilised in the ancient American civilisations long before it became known to Europeans. Lac and kermes, the Asiatic counterparts of cochineal, also contain colour principles belonging to the anthraquinone group. It is remarkable that naphthalene, which figures so largely in the production of synthetic dyes, is represented among natural colouring matters only by the small naphthoquinone group.

The majority of the natural yellow colouring matters are derived from xanthone or flavone, and much of our knowledge of these two groups is derived from the researches of Prof. A. G. Perkin, one of the authors, who has devoted himself for many years to the study of this intricate branch of organic chemistry. The flavone and flavanone groups have also received the attention of a band of Irish workers under the guidance and inspiration of Prof. Hugh Ryan.

The researches of Willstätter, carried out in the generously endowed Kaiser Wilhelm Institute at Dahlem, partly with the assistance of British and American collaborators, including Dr. Everest, the joint author of this treatise, have led to the elucidation of the chemical nature of many colouring matters of the γ-pyran group. The anthocyan pigments, present as glucosides in many flowers and coloured fruits, form a comparatively large class of natural colouring matters derived from pelargonidin, cyanidin, and delphinidin. These fundamental anthocyanidins are in all probability produced from the yellow flavonol sap pigments by a process of acid reduction. They are oxonium compounds, which are generally isolated in the form of their crystalline chlorides. These researches, which have demonstrated the chemical nature of the varied hues of the cornflower, salvia, pansy, aster, chrysanthemum, peony, hollyhock, and many other flowers, and of the colours of the ripe cranberry, bilberry, and black grape, are of the utmost scientific importance in extending our knowledge of the products of plant life.

The dihydropyrane group includes hæmatein, the colour principle of logwood, the most important natural dyewood, which is still extensively employed by dyers.

The chapter on the colouring matters of unknown constitution shows that there is still ample scope for patient study and systematic research among the natural dyes. There is a special reason now why these laudable efforts should be supported to the fullest extent and with Governmental assistance. Many of the plants yielding unclassified dyes have a tropical or subtropical habitat, and the fortunes of war are bringing these localities more even than formerly under the control of the Allied nations, to the exclusion of the Teutonic States. It behoves the statesmen of the victorious Allies to encourage to the fullest extent the work of those trained observers who are prepared to devote themselves to the study of these interesting and possibly utilitarian problems. The treatise under review, which presents a complete epitome of the researches carried out on natural dyes, will prove to be not only an indispensable work of reference, but also a source of inspiration to any scientific worker wishing to extend the boundaries of our present knowledge of these colouring matters.

G. T. M.

EDUCATION AND INDUSTRY.

Can We Compete? Germany's Assets in Finance, Trade, Education, Consular Training, etc., and a Proposed British War-cost Reduction Programme. By G. E. Mappin. Pp. 159+chart. (London: Skeffington and Son, Ltd., n.d.) Price 4s. 6d. net.

MR. MAPPIN'S book consists virtually of a number of essays on a wide variety of subjects, which include technical universities, town planning, land registration, the training of women to become self-supporting, the reclamation of peat bogs, etc.

From his observations as a student in Germany, Mr. Mappin describes how the different problems are there dealt with, and, where a comparison is possible with our methods, suggests the lines on which our industry, commerce, and education should be reorganised. The book lacks co-ordination between its various sections, and is written in a sketchy and unconvincing way. In making out a case in favour of certain proposals on German lines, the author over-emphasises the prevailing state of affairs in this country. Further, he does not appear to be fully familiar with many of the conditions he seeks to reform, advancement in some respects having proceeded far beyond his proposals.

In common with many would-be reformers, Mr.

Mappin appears to believe that there is a desperate need for an alteration in the conduct of affairs in this country, simply because similar affairs are undertaken on different lines elsewhere, and apparently he does not recognise that the success of national plans depends principally on the character, customs, and environment of the people, and that on this account what is successful in one country may be a failure in another.

Dealing with minor aspects of the book, many readers who have had opportunities of considering the matter will not agree with the author that British universities and technical colleges are so lacking as he maintains in their ability to display clearly the kind of courses that they provide. While many will agree that our public schools need much in the way of reform, they will scarcely support the contention that a boy goes to such a school *merely to get information*.

The author urges the claims of works schools, but is apparently unaware of the fact that there are numbers of well-established works schools in this country—some of very long standing. His suggestion that such schools should be supported financially by the premiums obtained from gentlemen apprentices is deplorable. Fortunately, the premium system in connection with manufacturing firms is fast dying out, and in this respect we have little to learn from Germany.

In reading the chapter relating to co-operation in works, one wonders whether the author is aware of the Whitley report, or of the widespread adoption of works committees.

In an appendix on technical universities emphasis is laid on the importance of practical work in co-ordination with the university training, and it is pointed out that in German universities one year of practical training is required before a degree is conferred. Apparently, Mr. Mappin is not aware that almost everyone in this country who has made a study of engineering training, and particularly the university authorities, are fully agreed that not one year, but at least two or even three years of practical training are necessary in addition to the university course, and that this practice is the prevailing one in this country for engineering students.

It is manifestly impossible to deal with the entire reform of industry, commerce, and education in this country in a volume of 159 pages, and the best that can be expected is the creation of a consciousness for a need for reform. This the author accomplishes to a considerable extent, but, to be convincing, the English conditions require much more thorough and accurate treatment than is accorded to them.

Throughout the book the author seems to consider only what he believes to be the deficiencies of this country, and fails to take into account our assets. The war was won largely because of the character of the people—their individuality, adaptability, and inherent industrial capacity. These factors will be predominant in the competitive times of peace.

ESSEX WATER SUPPLY.

The Water Supply of Essex from Underground Sources. By W. Whitaker and Dr. J. C. Thresh; the Rainfall by Dr. H. R. Mill. (Memoirs of the Geological Survey. England and Wales. Sir Aubrey Strahan, director.) Pp. iv+510+iv maps. (London: His Majesty's Stationery Office, 1916.) Price 15*s*.

THE issue of this volume, actually printed in 1916, was delayed by the War Office until November of last year. It is an important addition to the series of county water-supply memoirs, of which a dozen have already been published. In consequence of the wide extent of the county, and the many interesting problems connected with its water resources, this memoir exceeds in size any previous volume of the series. Along with the latest information concerning water supply, it contains many extracts from old records, showing the conditions in past times, and furnishing an instructive illustration of the progress that has been made in public health.

The separate sections are contributed by our leading authorities in these special subjects. Thus the geology and water resources have been treated in great detail by Mr. W. Whitaker, who during his official connection with the Survey obtained an intimate knowledge of the geology of the county, and since his retirement has devoted particular attention to its sources of water. Dr. J. C. Thresh, for many years the medical officer of health for Essex, through a prolonged study of the chemistry of the local waters, has contributed a remarkably comprehensive account of the subject, that is of the greatest general interest. Again, as in previous memoirs, the rainfall of the county has been dealt with by Dr. H. R. Mill, the director of the British Rainfall Organisation.

With the exception of the metropolitan area, Essex is dependent for its water supply on wells, with some slight assistance from springs. The chalk is the chief source, though in many parts, where reached only at great depths, it fails to yield large supplies. This is attributed to the relatively narrow and tight fissures, which probably exist beneath a considerable thickness of overlying beds. Second only to the chalk as water-bearing strata follow the sands, clays, and gravel beds of the Lower London Tertiaries, which in Essex are of more importance from a water-supply aspect than in any other county. Finally, the Boulder Clay, London Clay, drift gravels, and sands afford small local supplies of water at a relatively low cost, although their quality is not always above reproach.

One of the most interesting sections of this volume is that in which the chemistry of the chalk waters is discussed by Dr. Thresh. The waters obtained from the chalk, where deeply covered by Tertiary beds, are soft, and contain sodium carbonate, with a considerable amount of salt, in contrast to the normal hard chalk-water occurring at, or near, the chalk outcrop itself. Dr. Thresh shows by experiment that, by mixing dif-

ferent proportions of chalk water and sea water, and by passing the mixtures through Thanet Sand, the resulting filtrates can be made almost identical with the varying deep-well waters of Essex. It was already known that calcareous waters become softened after passing through certain silicates of alumina with potash, and Dr. Thresh advances the theory that a similar action occurs in the chalk waters of Essex, where they are in contact with, or have passed through, the Thanet Sand formation, the presence of sodium chloride being due to a slight influx of tidal or sea water.

Nearly four-fifths of this volume is devoted to the geological sections, water records, and water analyses of many hundreds of wells in the county; and, following a model index, four folding maps illustrate the distribution in Essex of the alkaline and saline chalk-wells, the chalk water-levels, and the isohyetal distribution of rainfall.

The amount of work involved in the preparation of this memoir must have been very great, but the utility of a treatise of this kind is in direct proportion to the amount of information provided. All those, therefore, who make, or are likely to make, direct use of this series of memoirs cannot but be grateful to the Geological Survey and the authors for the valuable and comprehensive data incorporated within the present volume.

H. L.

OUR BOOKSHELF.

Modern Chemistry and Chemical Industry of Starch and Cellulose. (With Reference to India.) By Prof. T. C. Chaudhuri. Pp. viii + 156. (Calcutta: Butterworth and Co. (India), Ltd.; London: Butterworth and Co., 1918.) Price Rs.3.12.

IN India, as in other British countries, the war has been the means of directing attention to missed opportunities, to unexplored and unexploited natural resources, and to new possibilities of industrial development.

Prof. Chaudhuri is apparently so much impressed with these matters that he has been unable to confine his attention to the subjects on which he set out to write. He provides his readers with a map of India "showing chief vegetable produces [*sic*]," throws in "some thoughts on industrial problem in India," and finally devotes a whole chapter to a review of recent developments in chemical industry in India. In spite of the inclusion of this interesting but irrelevant matter, he contrives to give a useful account of the chemistry of cellulose and starch, and of the great industries which depend on these important raw materials. The author has unfortunately succumbed all too frequently to the temptation to overload his description with unnecessary details, and has thereby been led in some cases into making statements which, to say the least, require qualification. He says, for example, that "there are various kinds of arrowroots—Indian, Brazilian, English, etc. They are all made at the present day from starch, which is obtained from different sources"; and again: "Arrowroot derives its name from the fact that the juice (cassava-root juice) was used by the West Indians as a poison for the tips of their arrows." There was no need to refer to a comparatively unimportant variety of starch such as arrowroot in a small book of this kind, and the information given is misleading, if not actually inaccurate. T. A. H.

The A B C of Aviation. By Capt. Victor W. Pagé. Pp. 274. (New York: The Norman W. Henley Publishing Co.; London: Crosby Lockwood and Son, 1918.) Price 12*s*. 6*d*. net.

"THE A B C of Aviation" justifies its title in that it is a very elementary treatment of the subject of aviation. The writer was chief engineer officer at the Signal Corps Aviation School, Mineola, U.S.A., and a good idea of the contents of the book is obtained by imagining the author to have set down in print what he observed of the aeroplanes and aeroplane parts which have passed through the stores of an aviation school. It is essentially superficial both as to theory and construction, and cannot be recommended as a serious introduction to the study of aerostatics or aerodynamics, or even for constructional design. The diagrams of the flow of air round an aeroplane wing are graphic, but very unreal; they show a large region of stagnant air over half the upper surface, which has no counterpart in the real flow of air over a wing.

The work is profusely illustrated with line drawings dealing chiefly with aviation, but with cursory reference to the balloon and airship, and the most useful feature of the book is its wealth of illustrative detail. Skeleton drawings are given of wings, fuselage, ailerons, elevators, and rudders. Each part of the aeroplane has its separate figure with a simple, clear statement of its name. There are full facilities for finding the disposition of the control surfaces, wires, etc., and the connections of the pilot's control column and rudder bar to the elevators, ailerons, and rudder. The engine controls are not dealt with in such a complete and simple manner, probably because the author has dealt with that branch of aviation in an earlier work.

Organic Chemistry, or Chemistry of the Carbon Compounds. By Victor von Richter. Vol. i., "Chemistry of the Aliphatic Series." Newly translated and revised from the German edition (after Prof. E. F. Smith's third American edition) by Dr. P. E. Spielmann. Second (revised) edition. Pp. xvi + 719. (London: Kegan Paul, Trench, Trübner, and Co., Ltd., 1919.) Price 21*s*. net.

THE first edition of Dr. Spielmann's translation was reviewed in our issue of March 16, 1916 (vol. xcvii., p. 54), and it is sufficient to say that the opportunity offered by the need for a second edition has been taken to correct certain misprints in formulæ and numbers which previously had escaped notice.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Canadian Government and the Proposed Hunting of Caribou with Aeroplanes.

In several English periodicals that have reached me I find reference to the correspondence in the *Times* concerning a suggestion emanating from Toronto that our barren-ground caribou might be driven in large numbers into corrals by means of aeroplanes and slaughtered in order to increase the meat supply. Such a suggestion has naturally created some alarm in the minds of many naturalists, sportsmen, and others in England, and hopes have been expressed that no such scheme would be permitted.

It is with the view of assuring zoologists in England and all those who are interested in the conservation of wild life that they need have no fear that such a scheme would be sanctioned by the Canadian Government, if it follows, as is usual, the recommendations of its advisers, that I am taking the opportunity of presenting a few of the facts concerning the subject.

On the recommendation of the Commission of Conservation and the Government's Advisory Board on Wild Life Protection, an inter-departmental committee, the North-West Game Act was completely revised two years ago. This Act governs the protection of game, fur-bearing animals, and wild life generally throughout the North-West Territories, which region includes all the portion of Canada north of latitude 60° (excluding Yukon Territory, which is governed, however, by an ordinance generally similar in its provisions, and Quebec). The main reasons for this revision were to give greater protection to the bison, musk-ox, caribou, and fur-bearing animals.

No person, other than a native, may hunt or kill caribou or other game without a licence from the Minister of the Interior. Such control is exercised for the express purpose of preventing harmful or excessive killing.

The idea of hunting caribou with aeroplanes is not new. Similar proposals have been made by different people at various times since the development of the aeroplane and its use in the war; some enthusiasts have added Maxim-guns to their means of offence. But to all such suggestions a deaf ear has been turned. During the war repeated efforts were made to secure a general relaxation of the game laws to permit the killing of game for food owing to the high price of meat. The Canadian Government resolutely opposed any such action, and a similar firm stand was taken by the Provincial Governments. It was realised that any such relaxation of the laws and the resulting excessive killing would mean the destruction almost to the point of extermination of many species of our game animals. The utilisation under Government control of the enormous herds of barren-ground caribou as a means of supplementing the domestic meat supply was very carefully considered by the Advisory Board on Wild Life Protection, but it was decided that the existing means of transportation and storage rendered any scheme of that nature impracticable at the present time. There is no doubt that with adequate protection it will be possible in the future to utilise the caribou, and, we hope, the musk-ox, which are the grazing animals most suited to that vast territory. But at the present time a policy of careful protection is being carried on by the Canadian Government.

All who are interested in the conservation of wild life may rest assured that the Canadian Government is carrying on a vigorous policy in this matter. In February last the first national conference on wild-life protection was held in Ottawa, and attended by officials and representatives from all the provinces of the Dominion. I am now preparing a report on the wild life of Canada and its conservation, which will probably be issued by the Commission of Conservation during the year. This volume will indicate the extent to which those responsible for the conservation of our Canadian wild life are fulfilling their responsibilities to posterity. Canadians are realising that Canada is the last stronghold for the greater portion of the big-game animals of North America, and are taking the necessary measures to ensure their adequate protection before it is too late. The rescue of the bison from the border-line of extermination will for ever stand as a monument to the foresight of the Canadian Government.

C. Gordon Hewitt.

Department of Agriculture, Ottawa, Canada,
May 2.

X-Rays and British Industry.

The remarks made by Major G. W. C. Kaye in his article upon "X-Rays and British Industry" (Nature, May 8) reflect so gravely upon British manufacturers that I must ask for the courtesy of a little space in order to comment on them.

Major Kaye apparently takes the view that British manufacturers, in the first place, persist in recommending induction coils rather than the more up-to-date transformers or interrupterless machines; and, secondly, do not put really intelligent design and construction even into the manufacture of the coils.

It is quite true that the invention of the interrupterless machine was due originally to an American, namely, Mr. H. Clyde Snook, but my firm placed machines of this type on the market before, I think, any American firm had produced them, and can certainly claim to be the pioneers in Europe of modern X-ray apparatus.

The difficulty in this country has lain not so much with the manufacturer as with the conservatism of medical men, the majority of whom have refused for years even to consider a closed-circuit transformer as compared with an induction coil, and, to a certain extent, hold the same opinion even to the present day.

Even now, although we are selling interrupterless machines almost faster than we can make them, it is unfortunately the case that the bulk of our output has to be sold abroad, and that there is still, comparatively speaking, little demand for them in this country, the medical public being still apparently content with putting in apparatus which would be laughed at in almost any other country in the world.

I should also like to say that, although I regard the induction coil as obsolete for ordinary radiography, it does still possess certain advantages for other work, notably therapeutic treatment, and I cannot agree with Major Kaye in his statement that the induction coil of to-day differs but little from its predecessor of Spottiswoode's day.

My firm bought the business of the late Mr. Alfred Apps, and therefore I am in a position to contrast the methods of Mr. Apps (rightly referred to in his day as the "prince of coil-makers") with the methods of the present day, and I can assure Major Kaye that progress has been a little more than he thinks, and that there have been rather more intelligent design and electrical knowledge applied to the instrument than he quite appreciates.

R. S. Wright
(Newton and Wright, Ltd.).

72 Wigmore Street, W.1.

MESSRS. NEWTON AND WRIGHT deserve great credit for their pertinacity in endeavouring to convince the British medical world of the particular merits of the Snook transformer. There is little doubt that, apart from gratifying the conservatism of a considerable section of their customers, most British coil manufacturers will presently be found concentrating their efforts on some type of interrupterless transformer.

The induction coil is no longer the best equipment for the X-ray operator. It is essentially inefficient, and, in addition, is often badly served by the (mercury) break. It has been pointed out to me that I made no mention in my article of Prof. Taylor Jones's admirable work on the induction coil. This was far from my intention. My concern would rather be with the extent to which his published results have affected the designs of the British coil manufacturer. Dr. N. R. Campbell recounts further interesting work on the subject in recent issues of the *Philosophical Magazine*.

The future does not lie with the induction coil, but rather with the closed-circuit A.C. transformer and some variety of hot-cathode valve (somewhat the same as in wireless telegraphy). This arrangement requires neither interrupter nor commutator, and the resulting simplicity will undoubtedly appeal to the medical man. Unless British manufacturers "get busy" on some such lines, the American manufacturer will have it all his own way in the future, certainly for overseas trade.

An effective association of British manufacturers might result in this country taking the lead in X-ray matters instead of developing American inventions.

G. W. C. KAYE.

Wasps.

A MODERATELY sized underground nest of the common wasp (*Vespa vulgaris*) examined by me on July 27, 1915, in Selkirkshire, was 8 in. in diameter, and contained an adult population of 417 workers and the queen. In addition, the six cell-flats of the nest contained 1159 eggs, 1216 larvæ, and 1076 pupæ, all of the first brood; 288 eggs, 248 larvæ, and 144 pupæ of the second brood; and 42 eggs, 30 larvæ, and 14 pupæ of the third brood. The actual living total at the time of examination, including eggs, larvæ, pupæ, and adults, was therefore 4635. In addition, there had apparently hatched from the cells then occupied by second and third broods 852 individuals, of which only 417 were accounted for when the nest was exterminated; the surplus brings the total to more than 5000. This was a nest which, when it was destroyed, had completed only the least active half of the wasp season.

A full account of the distribution of the different stages within the nest, and the deductions drawn therefrom as to the rates of egg-laying, cell-building, hatching, and mortality, appeared in the *Scottish Naturalist* for November, 1915.

In the same paper will be found particulars of the inmates of two other nests of the same species: one examined by Mr. A. Macdonald in September, 1915, in Kincardineshire, contained 1197 adults, 652 larvæ, and 680 pupæ, while the remainder of 5321 cells either contained eggs or were empty; the other, examined in October, 1912, by Mr. W. Evans in Midlothian, was found to contain 11,560 cells, and was estimated to have produced no fewer than 25,000 wasps in the course of the season.

JAMES RITCHIE.

Edinburgh, May 12.

DURING the year 1909 I destroyed 113 wasp-nests, also 87 in 1911, carefully took out the combs unbroken, and counted all the wasps that I could find (all wasps previously able to fly). They were mostly *Vespa vulgaris*, *V. germanica*, and a very few *V. rufa* and *V. sylvestris*. During 1910 I could find only one nest of *V. rufa*. Subjoined are a few records.

Wasp Records.

1909		1 ♀	at least in all nests.
July 21 ...	6 combs,	547 ♀♀	No large cells in comb.
,, 23 ...	9 ,,	1475 ,,	,, ,,
,, 24 ...	3 ,,	46 ,,	44 ♀♀, 67 ♂♂. *V. rufa.*
,, 25 ...	5 ,,	396 ,,	
,, 26 ...	7 ,,	1000 ,,	
,, 26 ...	4 ,,	389 ,,	106 ♂♂, 29 ♀♀.
,, 29 ...	6 ,,	472 ,,	*Vespa sylvestris.*
,, 29 ...	6 ,,	600 ,,	
,, 30 ...	9 ,,	2509 ,,	
,, 31 ...	9 ,,	2344 ,,	One large-celled comb.
Aug. 1 ...	9 ,,	2240 ,,	No ,, ,,
,, 3 ...	9 ,,	2560 ,,	
,, 5 ...	9 ,,	2413 ,,	Two ,, ,, *V. germanica.*
,, 6 ...	8 ,,	2557 ,,	One ,, ,,
,, 8 ...	10 ,,	3919 ,,	,, ,, ,,
,, 13 ...	3 ,,	287 ,,	156 ♀♀. *V. sylvestris.*
,, 15 ...	10 ,,	4287 ,,	One big-celled comb. *V. germanica.*
1911			
Aug. 9 ...	11 ,,	3420 ,,	Three ,, ,, ,,

These are a few records from about 300 acres of land here. I should conclude that 5000 ♀♀ wasps able to fly constitute a strong working nest of *V. vulgaris* or *V. germanica*, and perhaps *V. norvegica*.

RICHARD F. BURTON.

Longner Hall, Salop, May 9.

THE NATIONAL RESEARCH COUNCIL OF THE UNITED STATES.

AS the result of an executive order issued by President Wilson on May 11, 1918, the temporary arrangement inaugurated two years previously has acquired permanence as the National Research Council of the United States. The history of this organisation is instructive in showing that in time of national stress the Governmental authorities appreciate the necessity for active co-operation from scientific bodies or individuals who have in peace conditions received but little recognition or support.

During the War of the Rebellion, Abraham Lincoln caused the incorporation of the National Academy of Sciences, corresponding to the Royal Society, in order to have available, for national purposes, a body of men who were representative in their branches of science. Their duty was to investigate any problem of national importance when called upon to do so by a Government Department. The expenses of the work were to be defrayed by the State, but the academy received no compensation whatsoever. In the fifty-three years of peace which followed, the National Academy pursued its course as an ordinary scientific organisation of the highest class, giving advice to the Government from time to time when called upon to do so.

After the attack on the *Sussex* in April, 1916, the National Academy offered its services to the President for organising the research facilities of the country in order to prepare for any eventual active part of the United States in the war. This offer was accepted by the President, and the National Research Council was constituted. In July of that year the success which followed the organisation of research work by the National Academy of Sciences had already been sufficient to call forth the thanks of President Wilson.

During the succeeding eighteen months the National Research Council was thoroughly organised, and throughout this period rendered the greatest service to the nation in directing and conducting investigations connected with the prosecution of the war and with national welfare. Its activities were not confined to research alone, but a very important division occupied itself with general relations. Information was collected from foreign sources and distributed to those workers who had need of it. Large questions of reconstruction, education, and foreign relations were handled from the scientific and industrial aspects.

The technical divisions of the Council were as follows: Military; engineering; physics, mathematics, astronomy, and geophysics; chemistry and chemical technology; geology and geography; medicine and related sciences; agriculture, botany, forestry, zoology, and fisheries. Under these heads a large number of members were co-opted to deal with special subjects.

As will be seen, this very complete system enabled the National Research Council to bring under its direction practically everyone available whose capacity for research work was a national asset.

So successfully did the Council carry out the programme assigned to it that on May 11 of last year the President requested the National Academy to perpetuate the National Research Council in order that it might be available not only for war-time problems, but also for the large issues of peace.

The six paragraphs in which the President sums up the duties of the National Research Council are the clearest exposition possible of the relations of research and research workers to national efficiency, but they also point out what are the obligations of the nation towards stimulating investigation in the United States. Stress is laid on co-operative work, but it is pointed out that co-operation must be of such a type as to ensure individual initiative.

It is especially noteworthy in the President's order that collaboration of the scientific and technical branches of the Government, both military and civil, with the National Research Council is required. The nominations, however, to the Council from the Government bureaux are made by the president of the National Academy of Sciences. They are then designated by the President of the United States to take their place on the National Research Council. In this way the Government representatives are men whose scientific qualifications are vouched for by the president of the National Academy of Sciences.

Thus it is that the national direction of research work in the United States has become vested in a body of men whose conduct of research work during the war period of that country has shown that they are competent to handle the great problems which go with peace and reconstruction. The scheme is a wise one, because it calls for the closest co-operation between the Government and the research worker, but leaves the decision as to the methods of attack in the problems involved in the hands of experts.

The financing of investigations under the National Research Council was carried on with funds which aggregated 54,096*l.* for the fiscal year 1919. These were derived from the Rockefeller Foundation, the Carnegie Institution, and the President's Fund.

Two important developments have taken place since the foundation of the Council. The first is the result of the Rockefeller Foundation entrusting to the Council the sum of 100,000*l.* for expenditure within a period of five years for research in physics and chemistry in educational institutions in the United States. The primary feature of the project is the initiation of research fellowships. This will open a scientific career to a larger number of able investigators, and will meet an urgent need of the universities and industries. It is expected that fifteen to twenty fellowships will be available during the coming year.

The second development brings the Council into the closest touch with the scientific and technical societies of the United States. By a recent decision of the Council the majority of the members of a division must be representatives elected by the leading scientific societies. In the division of chemistry and chemical technology, for example, nine members are elected by the Chemical Society, one each by the Electrochemical and Ceramic Societies, and one by the Institute of Chemical Engineers. Only six members are chosen by the Council itself.

There can be no doubt that this programme, in which the direction of national research work is placed in the hands of capable men of science, in which ample opportunity is afforded younger men of originality to develop their genius, and in which the head of the State and his advisers have actively attested the vital necessity of original investigation in any scheme of national efficiency, initiates an era of scientific productiveness for the United States far greater even than the important output to which we were accustomed before the war.

C. G. L. Wolf.

WATER-POWER DEVELOPMENTS.

The prominence which has recently been given to the latent possibilities of power in streams, at present, from an industrial point of view, running to waste, has had the effect of stimulating public and professional interest to such a degree that reports and articles on the subject are now being published in close sequence, and we are appreciably increasing our knowledge of the conditions prevailing in appropriate regions, and of the measures which are desirable for exploiting such sources of power. The Royal Swedish Waterfalls Board is losing no time in developing the mountainous supplies of Lapland. The Canadian water-power departments are equally active as regards the hydrometric survey of Canada. Our own Government has taken the

welcome step of appointing a Board of Trade Committee to investigate the water-power resources of Great Britain and Ireland. Apart from State-controlled undertakings, we have the activities of unofficial bodies like the Water-power Committee of the Conjoint Board of Scientific Societies, the second report of which lies before us. It is a useful statement of information gleaned from inquiries in various parts of the world, but principally within the British Empire, since the publication in July, 1918, of the first report, which was summarised in NATURE of September 19, 1918. It dwells particularly and justifiably on the great strides which are being made in Canada. A perusal of this report in conjunction with a paper on "Science and Industry in Canada," read by Prof. J. C. McLennan before the Royal Society of Arts on March 4, certainly leads to a feeling of admiration for the energetic manner in which the Dominion has set about compensating itself for the shortage in its available coal supply. Although Canada takes second place in the list of the world's coal-fields, yet, owing to their geographical distribution and the difficulties of production, she has at present to rely to a very considerable extent on supplies from the United States.

The total estimated water-power of Canada is stated by Prof. McLennan to aggregate 18,800,000 h.p., divided somewhat as follows:—

	Per cent.	H.P.
Ontario	31	5,800,000
Quebec	32	6,000,000
Manitoba, Saskatchewan, Alberta, and North-West Territories	18	3,500,000
British Columbia	16	3,000,000
Remainder of Dominion	3	500,000

According to a census completed in February last by the Dominion Water-power Branch, the total hydro-electric power actually developed is 2,305,310 h.p., which is roughly 12 per cent. of the total available. Of this quantity, rather under one-tenth is exported to the United States, despite the fact that it is badly needed by Canadian industries in order to meet their increasing requirements. We have therefore the singular situation of Canada exporting electric power, of which she has none to spare, to the United States, and importing in return coal, of which she has abundant, but unworked, supplies. This artificial and uneconomical exchange is causing no little concern in responsible circles, because, if the United States should see fit to restrict its coal exports on the perfectly reasonable ground that the whole output is required internally for the domestic manufacture of raw material, those provinces in Canada (comprising the most populous manufacturing districts) which are remote from the Dominion coal-fields would suffer most, although they are rich in hydro-electric possibilities. Under Federal law no inconsiderable portion of the energy generated may be diverted to the United States. Take the Niagara Falls, for instance. Of 388,500 h.p. generated on the Canadian side in 1917, no less than 125,000 h.p. was exported to the United States, in addition to 265,000 h.p. developed on the American side itself. It is a delicate question, calling for delicate handling; fortunately the relations between the two countries are of the friendliest description.

Some of the largest Canadian installations, either completed or in hand, are Chippewa, 300,000 h.p.; Ontario Power Co., 210,000 h.p.; Shawinigan Falls, 200,000 h.p.

Developments in Australia are not nearly so marked; indeed, there is little additional information forthcoming. The chief electrical engineer of New South Wales estimates that 300,000 h.p. is continuously available from eighteen schemes already investigated. The chief of these are the Snowy River (137,400 h.p.) and the Clarence (100,000 h.p.).

There is little also to record from South Africa. In New Zealand there is some activity over a scheme by which 130,000 h.p. will be developed at three important sites on North Island.

The report of the Committee of the Conjoint Board concludes with an admonition to the engineers of Great Britain to be ready to take their part in inevitable and impending enterprises of great magnitude in hydro-electrical engineering. The Committee utters a warning that Canadian, American, and Continental engineers will continue to exercise a controlling interest in such projects unless an effort be made to contest the situation. It also directs attention to the lack of facilities at British universities for giving the necessary specialised scientific training to those seeking to enter this field of engineering, and it points to the example set by Cornell University, U.S.A., in laying itself out to meet the demand which is bound to arise for a training of this description.

BRYSSON CUNNINGHAM.

CHEMICAL SCIENCE AND THE STATE.

IT may still be doubted whether the public generally has any clear idea as to the occupation of the chemist and the purposes to which his work is directed. Usually he is confused with the dispenser of medicine, the pharmacist, who displays in his window the familiar globes of coloured water. By way of variety and as soon as his services were urgently required for purposes connected with the war he was classed by officials in the War Office with the *labourers* in the Arsenal at Woolwich, and he was paid at the same rate. It has, however, been gradually forced on the attention of the official classes that it is only the skilled scientific chemist who is qualified to devise and manufacture explosives, dyes, and drugs of the modern type, and that he alone can provide poison gases in warfare and their antidotes.

The Institute of Chemistry, of which the offices and laboratory are situated in Russell Square, W.C., was founded in 1877, and chartered in 1885. It is a body of professional men, all of whom have passed through a course of study and training extending over several years, with additional experience gained in practice as analysts and consult-

ants. During the progress of the war the institute has been in constant communication with the War Office and other Government Departments, and has been largely instrumental in mobilising the chemists of the country both for technical service with the forces and for the production of all kinds of war material.

The authorities having at last become aware that the services and advice of the scientific chemist are indispensable in the economy of the State, it appears eminently desirable that some representative body should be recognised as the mouthpiece of the several specialised organisations which have been one after another called into existence. The Institute of Chemistry already mentioned is a professional body with aims in reference to chemistry corresponding with those of the College of Physicians in relation to medicine. But the Chemical Society is much older, having been founded in 1841, and is, in fact, the parent of all the chemical associations now existing. It is composed of about 3400 fellows, and its object is the cultivation of the science of chemistry and the publication of the results of research. The Society of Chemical Industry, founded about the year 1880, is also a very numerous and influential body, consisting of manufacturers and others engaged in the application of chemistry to practical purposes. Beside these two large societies there are the more recently founded Society of Public Analysts, the Association of Chemical Manufacturers, the Faraday Society, the Biochemical Society, the Ceramic Society, the Society of Dyers and Colourists, the Institute of Brewing, and some others less purely chemical in character.

A short time ago the Institute of Chemistry addressed representations to the Government pointing out the necessity for introducing a definite system into the conditions of appointment of chemists directly engaged in the service of the State. There are already three first-class appointments held by officials entitled respectively the "Government Chemist," "War Department Chemist," and "Admiralty Chemist," but the subordinate offices are without a recognised system as to rank, qualifications, or emoluments.

There is, however, another question of some practical importance. In the event of the Government requiring information, advice, or opinion on any chemical question, to which of the bodies mentioned should inquiry be addressed? Hitherto the Government has been much in the habit of seeking advice on all kinds of subjects from the Royal Society, and getting it for nothing. During the war the Institute of Chemistry has given valuable information and assistance. But neither of these bodies can speak for British chemistry as a whole, and, since it is obviously undesirable for any divergence of opinion to show itself in connection with matters in which the public advantage or even safety is concerned, a new body has recently been called into existence consisting of duly appointed representatives of all the chemical societies and associations. It is hoped that this Federal Council for Pure and Applied Chemistry (the establishment of which was referred to in Nature for February 27 last, vol. cii., p. 591) will be recognised by the Government as qualified to speak for the whole of the chemists of this country; at the same time, its existence will promote the general recognition of the profession of chemistry and of its right to a position corresponding with that of the other learned professions.

NOTES.

The eighty-seventh annual meeting of the British Association will be held in Bournemouth from Tuesday, September 9, to Saturday, September 13, under the presidency of the Hon. Sir Charles Parsons, who will deliver an address to the association (dealing with engineering and the war) at the inaugural general meeting in the Winter Gardens on September 9 at 8.30 p.m. The sectional work will begin on Tuesday morning, and the days available for sectional meetings will therefore be Tuesday, Wednesday, Thursday, and Friday, September 9, 10, 11, and 12, and, if required, Saturday morning, September 13. The following presidents of sections have been appointed by the council:—A, Mathematical and Physical Science, Prof. Andrew Gray; B, Chemistry, Prof. P. Phillips Bedson; C, Geology, Dr. J. W. Evans; D, Zoology, Dr. F. A. Dixey; E, Geography, Prof. L. W. Lyde; F, Economic Science and Statistics, Sir Hugh Bell, Bart.; G, Engineering, Prof. J. E. Petavel; H, Anthropology, Prof. Arthur Keith; I, Physiology, Prof. D. Noel Paton; K, Botany, Sir Daniel Morris; L, Educational Science, Sir Napier Shaw; and M, Agriculture, Prof. W. Somerville. Evening discourses will be delivered on Thursday, September 11, by Sir Arthur Evans on "The Palace of Minos and the Prehistoric Civilisation of Crete"; and on Friday, September 12, by Mr. Sidney G. Brown on "The Gyroscopic Compass."

A meeting of subscribers to the Ramsay Memorial Fund will be held on Thursday, June 5, at 5 p.m., at University College, London, for the purpose of considering plans to be submitted by the executive committee with respect to the progress of the fund and to the objects to which the fund should be devoted. The total amount already given or promised amounts to 42,794*l*. 10*s*. 9*d*. This sum includes the following contributions, either in full payment or on account of the collections by the following overseas committees:—Switzerland, 817*l*. 6*s*. 9*d*.; United States of America, 626*l*. 15*s*. 10*d*.; Japan, 500*l*. 9*s*. 2*d*.; India, 397*l*. 8*s*. 4*d*.; Italy, 395*l*. 16*s*. 8*d*.; Denmark, 225*l*.; Norway, 186*l*. 6*s*. 7*d*.; Chile, 128*l*. 6*s*. 8*d*.; Holland, 68*l*. 1*s*. 7*d*.; Australia, 37*l*. 16*s*.; New Zealand, 21*l*. 3*s*. 6*d*. It also includes 5177*l*. 18*s*. 6*d*. collected by the Glasgow committee for a Glasgow fellowship. Promises, either provisional or definite, for the foundation of one, or more than one, Ramsay Memorial Fellowship have been received from the Governments of Italy, Japan, Spain, Norway, China, and Greece, and other Governments have the matter under favourable consideration.

Under the auspices of the French Government the Office Commercial Français en Angleterre has organised in London an exhibition of optical instruments and perfumery. The Office Commercial is a recently created department of the French Ministry of Commerce, and its object is to assist manufacturers to develop export trade. The exhibition is

being held at 153 Queen Victoria Street, and will be open until June 5. The optical exhibits include field- and opera-glasses, telescopes, kinematographs, surgical mirrors, laryngoscopes, spectacles, etc. So much advance has been made in this industry by British manufacturers during the war, and so little is known of it on the Continent, that we hope something will be done to hold in Paris and elsewhere an exhibition of optical and other manufactures in which we have achieved decided progress. Perhaps arrangements can be made to transfer to some Continental cities the main part of the British Scientific Products Exhibition to be held at the Central Hall, Westminster, during July.

In view of the present industrial unrest and the difficult social problems with which the country will be faced during the next few years, the promotion of better relations between employers and employees demands scientific study. The National Alliance of Employers and Employed, through its organ *Unity*, is adopting the enterprising step of offering a series of prizes presented by Sir Robert Hadfield, and amounting in all to 200*l*., for the best essay on either of the following subjects:—"A Practical Scheme for the Joint Development of Industry by Capital and Labour," "The Most Effective Means for the Prevention of Unemployment," and "The Most Effective Means for the Prevention of Industrial Disputes." The committee of award will consist of the Right Hon. Fredk. Huth Jackson (chairman of the National Alliance), the Master of Balliol College, Oxford, and the Right Hon. Arthur Henderson. Essays must not exceed 3000 words in length, and must be addressed to the Editor, *Unity*, 64 Victoria Street, London, S.W.1, marked "Essay Competition." The competition closes on August 30, and the rights of publication of essays submitted are to be vested in *Unity*.

The difficulties experienced by many university graduates in obtaining employment suitable to their education and abilities received careful consideration at a recent meeting of representatives of the universities, the Imperial College of Technology, and the Federation of British Industries, under the chairmanship of Sir Richard Vassar-Smith. The proposal to set up an organisation which might act as a "clearing-house" between the universities and the industries of the country was received so favourably that it was decided to hold a further meeting to consider the practical details of the scheme. An efficient organisation of the nature suggested should ensure that all grades of university students would have the opportunity of passing into that type of productive employment in which they would be able to use their abilities to the fullest extent. It would also make for that closer co-operation between the university and industry which is so essential for national prosperity in the years to come. The marked tendency for the university graduate to proceed overseas would undoubtedly be checked by the offer of suitable employment in this country, and the setting up of such an organisation will meet with the approval of all interested in national well-being. The carrying out of the scheme at an early date would exert a considerable influence on the maintenance of that steady flow of workers through the university to commerce and labour which is looked forward to on all sides.

A petition in opposition to the Dogs Protection Bill, with more than eight hundred signatures, chiefly of residents in Leeds and other cities in Yorkshire, has been collected by a few private individuals in ten days, and has been forwarded to the Home Secretary. It was pointed out that, in the opinion of the petitioners, the Bill would do harm by interfering with the progress of medical research. The list of signatures included the heads of many of the departments of science, technology, and medicine in the University of Leeds, as well as many important members of the administrative staff of the University. There were also names of many members of the infirmary staff, important civic persons, and representatives of the clerical, legal, dental, nursing, and other professions. The Bill was amended in the House of Commons during the report stage on May 23 by the insertion of a provision, moved on behalf of the Government, permitting experiments where the object in view would be frustrated unless it was performed on a dog. The amendment was carried by a majority of 78, and the Bill now awaits a third reading.

The Society for the Prevention of Hydrophobia (founded in 1886) is being reorganised for the purpose of influencing public opinion and urging the Government to adopt universal muzzling for eight months, accompanied by six months' quarantine on all imported dogs, which past experience has shown to be the quickest, safest, and only means of completely eradicating rabies and hydrophobia. It is the stray, wandering, and uncared-for dogs, which infest every town and village, that are the most likely to be bitten by a rabid dog escaped from an infected area and to spread the disease farther afield. Universal muzzling would lead to the seizing and elimination of all stray dogs before a rabid dog arrived in the district. To wait until a rabid dog *has arrived* in a district and infected one or more of these strays is a fatal mistake. A forty-mile radius is all very well for cattle disease and swine fever, but not for rabies. Amongst those who have lately joined the committee are Sir John McFadyean, principal of the Royal Veterinary College; Dr. C. J. Martin, director of the Lister Institute; Mr. Stephen Paget, and Major Penberthy, president of the Royal College of Veterinary Surgeons (1897). Mr. J. Sidney Turner has been elected chairman. Vice-presidents will include Surg.-Gen. Sir David Bruce, Sir J. Rose Bradford, the Earl of Chesterfield, Sir Watson Cheyne, Bart., Earl Curzon of Kedleston, Major David Davies, the Duchess of Newcastle, Lord Bledisloe, Mr. Leslie Scott, K.C., and the Hon. A. H. Holland-Hibbert.

An outline of the progress in practical radiotelegraphy during the past four years was given last week by Mr. Godfrey Isaacs in an address before the members of the Aldwych Club. The range of maritime communication, which before the war averaged 200 miles by day and 500 miles at night, had been quadrupled. "Jamming," apparently, has been eliminated, and Mr. Isaacs said ships would in future be able to telephone and telegraph either to ships at sea or to the coast without any possibility of interference. The wireless "direction-finder" would enable the pilot of an aeroplane or airship to ascertain approximately where he was at any time. A further development had produced a new transmitter, which would project into the air a wide, divergent beam, something like a searchlight without the light, which would extend over any area required, or, if it was desired, a concentrated beam over some small place, and these beams would convey to the men in the sky automatically the name of the place they were passing over. Similarly, these beams could be equipped to lightships or buoys in fixed and defined positions, so that even when passing over the sea an airman would know exactly where he was. With regard to land communications, very little was done before the war, particularly in well-populated countries, such as those in Europe, in connection with wireless telegraphy, for the reason that if they had

had a number of wireless telegraphy stations in close proximity, interference with each other would have made an efficient service quite impossible. That was a thing of the past. There was no reason why there should not be wireless telegraph and wireless telephone services between all the principal centres throughout this country. London could talk to Manchester or Edinburgh or Dublin without any possible danger of interfering with any other station, and those messages could not be overheard by any other station. In telegraphing and telephoning, the same thing exactly applied. Mr. Isaacs regarded that as an epoch-making invention. He thought a very great service would be done if wireless telegraph and wireless telephone services were constructed as auxiliaries to land-lines. Wireless to-day could do 150 words per minute simplex and 300 words a minute duplex. It would require but a very small mechanical improvement to double and quadruple that number of words transmitted by wireless. Mr. Isaacs was quite satisfied that, so soon as wireless traffic needed the greater speed of transmission, mechanical improvement would be introduced, and they would get something in the neighbourhood of 600 words per minute.

MR. VAUGHAN NASH and Sir T. H. Middleton have been appointed Commissioners under the Development and Road Improvement Funds Acts.

SIR ALBERT STANLEY has, on account of ill-health, tendered his resignation as President of the Board of Trade, and Sir Auckland Geddes has been appointed as his successor.

THE appointment of the Ray Lankester investigator having been suspended during the war, the following have now been appointed, beginning or expected to begin work at the Plymouth Marine Biological Laboratory on the dates named:—Mr. L. R. Crawshay, March 1 (Porifera); Mr. H. M. Fox, June 21 (marine insects); Mrs. Redman King, July 3 (Echinus); and Prof. W. Garstang (Ascidians).

THE Ipswich Field Club has lately investigated two of the tumuli on Martlesham Heath, Suffolk, and proved them to belong to the Bronze age. Mr. J. Reid Moir, who superintended the work, gave an account of the results to a meeting held on the spot on May 17. He showed the remains of a very thin bronze bowl, which seemed to be partly covered with a material like linen in a good state of preservation. It contained incinerated human bones, part of a bone comb, a bead, and other fragments apparently of ornament. Traces of hearths were distinct in the larger mound examined.

THE Board of Agriculture and the Road Board have appointed a joint sub-committee to arrange for experiments to be carried out to ascertain whether there is any foundation for the allegation that tar-treated roads are a source of danger to fisheries; if so, to what extent; and what measures can be taken to minimise or obviate the possible danger. The sub-committee consists of:—Dr. Jee, Chemical Adviser to the Board of Agriculture; Dr. Hammond Smith, Scientific Adviser to the Salmon and Trout Association; Mr. W. J. A. Butterfield, Consulting Analytical Chemist to the Road Board; and Mr. W. J. Taylor, County Surveyor of Hampshire.

IN a recent issue of the *Fishing Gazette* (April 5) Mr. W. J. A. Butterfield discusses the question of the poisoning of fish by road-washings. As regards tarred roads, it is noted that the constituents of coal-tar most directly injurious to fish are the phenols. These may be present to the extent of 3 per cent. in tar for road use, though generally the proportion is much less. Water dissolves out a little of the phenols, and such contaminated water draining into rivers may, no doubt, under particular conditions, be deleterious to fish, although experiments have shown that, so long as the proportion of phenol is not more than 0.25 in 100,000, the water is perfectly safe. Considerable pollution is possible where the river runs through a valley and is crossed by the road, so that drainage from the inclines on either side flows into the river. The periods when a tarred road is likely to be most dangerous to fish life are (1) when the tarring is quite fresh and followed by heavy rainfall, which washes away some of the tar before it has set; and (2) when the coating of tar is broken up by wear-and-tear, so that rain can percolate freely through it. A tarred surface "scarified" preparatory to remaking may be very dangerous to fish, and care should be taken that the material removed is not left lying where rain-washings from it will enter fishing waters. Oil-droppings from motor traffic are, speaking broadly, unlikely to be directly mischievous, but indirectly they may be injurious through destruction of insect life, on which the fish depend for their food supply.

DR. GEORGE FERDINAND BECKER, who was on the staff of the United States Geological Survey since 1879, died on April 20 in Washington, at the age of seventy-two. His name will always be associated with the days when the survey, by the liberality and the wide distribution of its publications, began to make itself known throughout the scientific world. Becker's work was mostly devoted to the geology of important mineral deposits, and he showed again and again how mining development assisted in the understanding of the relations of rock-masses in the crust. His monograph on "The Geology of the Comstock Lode," published in 1882, directed attention, at a comparatively early date, to the importance of the study of thin rock-slices with the microscope, and its beautiful series of illustrations followed only three years after those issued by Fouqué and Lévy in their famous "Minéralogie micrographique." The width of range in Becker's work is further illustrated by his bulletin on "Schistosity and Slaty Cleavage" (1904), in which he urged that rock-cleavage is due to a weakening of cohesion, antecedent to rupture, on planes of maximum slide, supporting his thesis by experiments on natural clays.

BY the death of Mr. Richard H. Curtis on May 21 meteorology has lost one who took a keen interest in its various branches for more than half a century. Mr. Curtis entered the Meteorological Department of the Board of Trade under Admiral FitzRoy in 1861. For a long time he prepared for the Press the results of the work of observatories, and in 1907 he became superintendent of the instruments and observatories division of the Office. For many years Mr. Curtis lived at Warlingham, Surrey. He retired from the Meteorological Office in 1912 at the age of sixty-five, but continued to supply anemometric records to the Office and rainfall records to *Symons's Meteorological Magazine* until a few months ago. He was a fellow of the Royal Meteorological Society, and served on the council for several years. Mr. Curtis contributed many papers to the society's Journal on various subjects, and especially on sunshine and wind-force. He introduced an improvement in the mounting for the lens and bowl of the Campbell-Stokes sunshine recorder, and carried out interesting experiments on the distribution of wind-pressure upon flat surfaces. He also aided in working up the atmospheric effects of the Krakatoa eruption of August, 1883, the results of which were incorporated in the report by the Royal Society.

MR. E. TORDAY contributes to the April issue of *Man* an interesting account of the Northern Babunda tribe, an offshoot of the Kimbundu of Angola. They are a fine, tall, heavy-boned, short-legged, very dark skinned race, with pleasant features. With the exception of infants they are all clothed, not in Manchester goods, but in cloth home-made from the fibre of the raphia palm. All negroes are keen traders, and trade is the principal occupation of the men; but a great market is scarcely ever held which does not end in a fight between two hostile factions. The crops of the field belong to the woman who tilled it, and it is her duty to feed her husband and her children. Large numbers of slaves are kept, who may be freely sold, but the owners cannot put them to death. No persons who can trace a common ancestor are allowed to marry, and prenuptial infidelity is the normal rule. They are fond of music, and sing better than any other tribe on the Congo. A large collection of their musical instruments has been made for the British Museum.

THE attention of coleopterists may be directed to Dr. F. H. Gravely's "Contribution towards the Revision of the Passalidæ of the World" (Memoirs Indian Museum, vol. vii., No. 1, pp. 146+16 figs.+1 plate, December, 1918), in which, in addition to the systematic part, the external morphology, classification, and geographical distribution of these beetles are discussed.

THE Commonwealth Bureau of Meteorology has published in one sheet a layer-coloured orographical map of Australia on an approximate scale of 4½ millions. The map has been compiled by Dr. Griffith Taylor, who has collected all the available data for the task. In the little known and the unexplored parts of the country the contours are only roughly approximate; in fact, Dr. Taylor describes all the contours as form lines. A note appended to the map gives the authority for the data used in each State. Some improvement might well be made in the lettering and printing, but the map, on the whole, is a useful production and a great improvement, from the orographical point of view, on pre-existing maps. It may be taken for the time being as the authoritative version of the relief of Australia.

AN interesting experiment on the registration of distant earthquakes is described by Messrs. T. A. Jaggar and A. Romberg in the Bulletin of the Seismological Society of America (vol. viii., 1918, pp. 88–89). An Omori horizontal pendulum was used, but the smoked paper and stylus were replaced by an optical system. The arm of the pendulum was continued by a magnetised steel needle. A second needle of the same size was fixed to the back of a light circular mirror, at right angles to the mirror, and with its north pole close to the south pole of the arm magnet. The mirror was cemented to a vertical taut silk fibre held on a post standing on a concrete table, and both pendulum and mirror were damped by projections immersed in oil. During a horizontal displacement of the ground the supports of the pendulum and mirror were moved, while the frictionless magnets rotated the mirror round a vertical axis. The seismogram reproduced (July 2, 1918), made on a Kodak film travelling at 32 mm. per minute, shows the first and second preliminary phases with extraordinary clearness.

IN connection with recent efforts to promote the cultivation of sugar in Bihar, Rai Bahadur Joges Chandra Ray publishes an interesting article in the Journal of the Bihar and Orissa Research Society (vol. iv., part iv.) on the sugar industry in ancient India. In the Vedas there is no mention of any saccharine substance other than honey. Cane was cultivated, but we do not know whether it was used for chewing or pressed, or whether its juice was dried for future use. The original seat of the cultivation of the Paunda, or thick cane, seems to have been northern Bengal. We do not know how the ancients clarified the cane-juice or refined their sugar. Probably the method was much the same as that which obtains now in Bengal and elsewhere, and clarification was secured by skimming off the scum which rises to the surface. It is remarkable that no account of palm-sugar is found in ancient Sanskrit works, and the industry in Bengal seems to be of comparatively recent date. There is a prejudice against its use as the tree yields an intoxicating beverage.

BULLETIN No. 3 of the Scientific and Industrial Research Department consists of a study of the performance of night glasses by Mr. L. C. Martin, of the Imperial College of Science, London. The work arose out of the exacting demands the war made on the optician for a telescope suitable for observing in a feeble light, and the object was to determine the best proportions and conditions of use of an instrument with a given size of objective. The author's conclusions may be summarised as follows:—The binocular form is most convenient. For hand binoculars for general purposes a magnification of 6 should not be exceeded. The exit pupil should be 0·7 or 0·8 cm. in diameter, and a large field of view is desirable, as it increases the ease of observation. For stand instruments a magnification of 10 is most suitable for general purposes. Where higher magnification is necessary it is of the utmost importance to protect the observer's eye and the field of view from all stray light. To diminish the number of glass air surfaces, a cemented prism erecting system should be used.

A PAPER contributed by S. L. Archbutt and D. Hanson at the recent meeting of the Institute of Metals describes in detail the methods found most suitable for the preparation of specimens of aluminium alloys for microscopic examination. Particular care must be given to the grinding and polishing operations, since the successful development of the microstructure depends to a very large extent on the condition of the prepared surface. Hand-grinding on graded emery papers which have been previously soaked in paraffin is found to give excellent results, while for the polishing operation a motor-driven disc covered with smooth-surfaced woollen cloth is employed. Magnesia is used as the polishing powder, but for soft alloys the final stages are carried out on a wet pad practically free from magnesia. With regard to the etching both of aluminium and its alloys, the authors recommend a 10 per cent. solution either of caustic soda or of hydrofluoric acid in water. Methods for the identification of the various impurities occurring in aluminium and of the different micrographic constituents found in the commoner aluminium alloys are also described. These have been investigated in great detail with the object of finding reagents which will distinguish between these different constituents when they occur in the same alloy. Alloys of aluminium with silicon, iron, copper, zinc, nickel, magnesium, and manganese are considered in this connection.

WE are very glad to see that M. L.-P. Clerc, who is so well known in this country, and took up military duties at the very beginning of the war, has resumed his activities in connection with the French Photographic Society. In a recent issue of the society's Bulletin M. Clerc publishes a paper (reproduced in the *British Journal of Photography* for

May 16) on the use of alcohol for the rapid drying of gelatine negatives and prints. He gives curves that show the drying action of alcohol under various conditions, but perhaps the most interesting result is the cause of the white deposit that so often appears when this method is used. It is due to bicarbonate of lime deposited because of its insolubility in alcohol. By immersing the negative in very weak hydrochloric acid (10 c.c. of commercial acid to a litre of water) immediately before putting it into the alcohol, the deposition is avoided. This weak acid will remove a deposit that has been allowed to form, and if the patch is of small area it may be made to disappear by breathing on it for a short time, because of the moisture and carbon dioxide in the expired air. Of course, the use of soft water obviates this annoyance, but the use of pure alcohol instead of "denatured" spirit does not, though this has often been prescribed as a remedy.

MORE than sixty years ago Pasteur showed that glycerol was formed during the alcoholic fermentation of sugar. The quantity found was about 3·6 per cent. of the sugar fermented. Later, Laborde showed that the quantity of glycerine produced varied according to the kind of yeast used and its amount, more than double the foregoing proportion being obtained in some cases. Even so, this is a very small yield if fermentation is regarded as a source of glycerol. It is understood, however, that during the late war our opponents supplemented their production by fermentation methods when fats, the ordinary source, ran short. In *Helvetica Chimica Acta* (vol. ii., No. 2) K. Schweizer indicates the method used. It is known that glyceric aldehyde and dihydroxyacetone can be converted into glycerol by means of reducing agents, and there is some evidence that one or both of these substances may be produced as intermediate compounds during fermentation. The working hypothesis, therefore, was that these compounds, in the nascent state, would be acted upon by a reducing agent and converted into glycerol to a greater extent than in ordinary fermentation. This was found to be the case. On adding sodium sulphite, and working with a neutral liquid, a yield of more than 21 per cent. of glycerol was obtained.

MONOMETHYLAMINE being a synthetic reagent of considerable importance, a new method for its preparation will probably be of interest to organic chemists. The reduction of chloropicrin yields different products according to the reducing agent employed. Raschig showed that when chloropicrin is reduced with stannous chloride and hydrochloric acid, cyanogen chloride is produced. If, however, iron-filings and acetic acid (Geisse) or tin and hydrochloric acid (Wallach) are used, monomethylamine is the major product. Prof. P. F. Frankland and Messrs. F. Challenger and N. A. Nicholls have studied the conditions of the reaction (Journal of the Chemical Society, February, p. 159) and recommend the following procedure:—Iron-filings (500 grams) are gradually shaken into water (2500 c.c.) containing hydrochloric acid (60 c.c.), and contained in a large earthenware jar which is fitted with a stirrer and placed in a little cold water. The chloropicrin (250 grams) is then gradually added, with very efficient stirring. The temperature rises, and should be maintained at about 50° C. The smell of chloropicrin disappears after three hours, and the mixture is then gradually added to a boiling solution of sodium hydroxide into which steam is blown. The methylamine is absorbed in hydrochloric acid, the solution evaporated, and the residue dried to constant weight. In this way a yield of 95·5 per cent. of the amine hydrochloride containing only 3·5 per cent. of ammonium chloride is obtained. When reduced with a hot alkaline solution of ferrous sulphate, chloropicrin gives a considerable amount of ammonia. The method described for the preparation of methylamine should prove valuable now that large quantities of chloropicrin are readily procurable.

A NEW weekly journal devoted to industrial and engineering chemistry, and entitled the *Chemical Age*, is announced for publication on June 21 by Messrs. Benn Bros., Ltd., Bouverie Street, E.C.4.

OUR ASTRONOMICAL COLUMN.

THE SOLAR ECLIPSE.—The total eclipse of the sun that will happen to-day is remarkable for the small amount of attention that is being given to observations of the corona and the sun's surroundings that have formed the main object for which eclipse expeditions have been organised during the last half-century, but in place of these the opportunity is being used to make investigations in several modern branches of science. The Committee of the British Association for Radio-telegraphic Investigation has arranged a programme for sending and receiving signals to determine their strength during the eclipse. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington has arranged observing parties at stations in America and West Africa, who, in co-operation with various observatories and individuals, will make special magnetic and allied observations inside and outside the shadow belt. As has already been announced, the British expeditions to Brazil and West Africa will photograph the field of stars around the sun for the purpose of detecting any displacement due either to gravitation according to the relativity theory published by Einstein in 1915, or to the effect of the sun's gravitation on the mass that light is believed to have according to the electromagnetic theory.

JUNE METEORS.—Though twilight is strong in the midsummer month, meteors are fairly numerous, and probably more so than in April and May. Fireballs are often seen, and particularly from a radiant point in Scorpio. There is a possible cometary radiant on June 10 from 273×0, and three others during the last week of the month from 313×60, 13×6, and 213×53. The last appears to be probably connected with the comet of Pons-Winnecke, which afforded an unusually rich shower on June 28, 1916. Though no return of this display can be confidently expected until 1921 or 1922, it should be looked for every year, as it may form an annual exhibition, though really abundant at intervals of about every six years. The great shower of Perseids begins early in July, and there is strong evidence that the same system furnishes an occasional meteor at the end of June. Observers should therefore watch especially for such an object during the moonless nights at the end of June this year.

PARIS OBSERVATORY REPORTS.—The reports of the French National Observatory have been made and presented to the council annually during the war, and those for the years 1916–18 have lately been received. The work has naturally been much curtailed owing to the absence of many of the staff on military service, and a projected modification of the programme with the principal meridian instrument has had to be held in abeyance. Also, it was considered prudent to take precautions against damage to this and other instruments, so that the reports show little in the way of observation, the energies of such observers as were available being devoted entirely to the requirements of the time service, the errors of the clocks being

determined by the smaller instruments, and to some extent by the *astrolabe à prisme*, which has been confided to the care of Mme. Chandon. In the middle of the year 1918 a provisional observatory was installed at Lyons, to which the astrolabe and other instruments for determination of time were transferred. M. Henri Renan has retired from the service of the observatory after forty-four years' service, and M. Puiseux, who entered the observatory in 1879, resigned his office in the year 1917.

THE ATLANTIC FLIGHT.

The safety of Mr. H. G. Hawker and Comdr. Mackenzie-Grieve, after their daring attempt at a direct flight across the Atlantic, is at present the feature of special interest. The *Times* of May 26, referring to the news, says "it will cause as keen and as widespread a joy as the news of many a victory in the war." Without doubt the safety of the two airmen has lifted a cloud which threatened to overshadow other competitors.

Much fog was encountered immediately after the start from Newfoundland, and, later, cloud and a squally northerly wind. The flight was made chiefly at an elevation of about 10,000 ft. A direct course for the British Isles was being made, and the aircraft had completed one-half of the journey eastward when, according to Mr. Hawker, "the machine stopped owing to the water-filter in the feed-pipe from the radiator to the water-pump being blocked up with refuse." It is said that there was no trouble in landing on the sea, and Mr. Hawker and Comdr. Grieve were picked up by the Danish tramp steamship *Mary* in lat. 50° 20′ N. and long. 29° 30′ W., after being in the water about one and a half hours, at 8.30 a.m. G.M.T. on May 19.

The *Mary* left New Orleans on April 28, bound for Denmark. Fortunately, this vessel was close at hand when the aircraft was in difficulty. An examination of the wireless weather reports published by the Meteorological Office in the International Section of the Daily Weather Report indicates that Atlantic liners were apparently nowhere near at the time.

From weather maps prepared, it seems that fair north and north-west winds were blowing from Newfoundland to about mid-Atlantic, with cloudy weather, the conditions being chiefly anticyclonic. Further eastward there was a cyclonic disturbance which occasioned gales and heavy weather. This storm system hovered in about the same position to the westward of Ireland for a fortnight, which, meteorologically, is very exceptional, its passage being barred by a region of high barometer which has persistently hung over Scandinavia. Such anomalies offer a decided difficulty to trans-Atlantic flying, although with more perfect engines and further improvement in the flying machines these difficulties will, without doubt, be overcome in time.

We join with the entire British public and others in hearty congratulations on the happy ending of the venturesome and courageous voyage.

The *Daily Mail* has generously decided to give a consolation prize of 5000*l*. for division between Mr. Hawker and his navigator.

The United States Navy seaplane N.C.4, which accomplished a flight to the Azores from Newfoundland on May 16–17, left Ponta Delgada on May 27 and arrived at Lisbon on the same evening. This stage of the journey was about eight hundred miles, and the third stage to Plymouth, by which the trans-Atlantic flight is to be concluded as we go to press, is about nine hundred miles.

CARNEGIE LIBRARIES AND EDUCATIONAL WELFARE.

The fifth annual report (1918) of the Carnegie United Kingdom Trust was submitted by the executive committee to the trustees on February 26, and has now been published (Edinburgh: T. and A. Constable). The work of the Trustees suggests that, as it is the fashion now to create new Ministries, there is a splendid opportunity for the Prime Minister to appoint a Minister of Philanthropy. Mr. Carnegie, with the most benevolent intentions, spent about two millions on libraries, and, while undoubtedly many towns owe him gratitude for his gifts of fine buildings, we fear the balance would show that he probably did more harm than good. Many of these libraries have proved to be mere white elephants, their upkeep in many cases practically exhausting the whole of the available income, resulting in miserably paid and ineffective staffs, and nothing left for the purchase of books. In some cases less than 1*l*. has been spent on books during an entire year. Whether or not Mr. Carnegie realised this before the end of his personal benefactions we cannot tell, but he very wisely handed over a large sum to carefully chosen trustees, who from the first have laid themselves out to amend past mistakes and make sure that fresh benefactions should be granted with some surety of lasting good results; they have, therefore, steadily refused to make building grants where the yield of the rate is inadequate for the maintenance of a proper library.

The trustees have taken education and the welfare of the people in the widest sense for their province, and they have made the renewal of their annual grants dependent on results. The report is well worth reading. Taking as their model the excellent Yorkshire Village Library scheme, which for more than fifty years has done so much for the working classes, the trustees have established and maintained rural circulating libraries throughout the country, including both Scotland and Ireland, some under the county education authorities, some in relation with town libraries, and others under the charge of the local clergy or schoolmasters. They have established and supported play centres for "toddlers"—that is, children below five years—and, for older children, cricket, football, and other games, all complete with pavilions and everything necessary. In fact, their motto for all such enterprises appears to be "thoroughness." Baths and wash-houses have not been forgotten, and one of their most recent experiments is the encouragement of music by offering rewards for compositions, which are published when judged worthy by their experts. Recognising that music takes a very high place among the instruments for elevating and refining the mind, they have requested Sir Henry Hadow to "investigate and describe the agencies which exist for promoting the practice and appreciation of the art of music among the people of the United Kingdom, and to report what steps might be taken towards their further encouragement in the future." Under the direction of Dr. Terry, considerable progress has been made with the recovery of the works of the musicians of the Tudor period and the transcription of them into modern notation.

The trustees have made a grant of 4000*l*. to the National Union of Women Workers for travelling welfare exhibitions in England and Scotland, the expenditure to be spread over two years; and a sum of 750*l*. for the same purpose has recently been paid to the Women's National Health Association for Ireland. Taught by their five years' experience, they direct special attention to that blot on our public

library system, the limitation of the rate, which prevents even the most powerful of our corporations spending whatever they think fit for the maintenance and development of their library systems. If there is to be any real reconstruction in the educational system of this country, this obstacle to progress should receive the immediate attention of the Government.

RECENT RESEARCHES ON CHOLERA.[1]

THE subject I have chosen to speak about to-day is one regarding which probably but little is known outside the medical profession except that a great reduction in the death-rate has been brought about in recent years in perhaps the most justly dreaded disease of India, namely, cholera. I propose to give you a brief account of my prolonged researches extending over more than a decade, and dealing with several distinct problems by means of a variety of methods of research, physiological, physical, and chemical, as I think this work will best illustrate the value of various collateral sciences in medical research.

The treatment of cholera at the beginning of the twentieth century remained much as it was seventy years before, when Latta and Mackintosh in Edinburgh in 1831 introduced the plan of injecting large quantities of normal saline solution into the veins to combat the collapse stage of cholera. This brilliant idea just failed to be a great discovery because no means were then found of retaining the fluid in the circulation, so that the apparently miraculous immediate effect of reviving the patient as one from the dead was usually followed by fatal recurrence of the terrible drain of fluid from the system. At the time I commenced my investigations the method was seldom used, as shown by the fact that a search through the records of the Calcutta European General Hospital from 1895 to 1904 showed no case in which large saline intravenous injections were given, while the mortality among ninety-five cases in those nine years reached the appalling figure of 87·4 per cent. Indeed, it was generally recognised that once a European patient reached the collapse stage in cholera recovery scarcely ever took place.

Recent Researches on the Treatment of Cholera.

As the first whole-time professor of pathology in Bengal, the home of cholera, who stuck to unlucrative research work for any length of time, this fell disease naturally attracted my attention, but it was not until after the completion of the first edition of my work on fevers in the tropics, the collection of material for which occupied me for twelve years, that I was able to take up serious work on cholera in 1908. I had previously made a number of blood-counts, and, with the help of my friend Major Megaw, had studied in 1906 Latta and Mackintosh's plan of injecting large amounts of normal or isotonic salt solutions—that is, one containing the same proportion of salts as the normal blood, controlling the quantities injected by special blood, and blood-pressure examinations—in the hope that, with the aid of these modern methods, better results would be obtained. This hope was largely disappointed, as the mortality only fell from 59 per cent. during the previous eleven years to 51·9 per cent. in 1906, and the method, which is a time-consuming one, was once more abandoned as of little service.

On thinking the matter over while on furlough, it occurred to me that on the physiological principle that a high salt content tended to retain fluid in the blood, it would be worth while to try a stronger salt solution, and on return from leave with renewed energy at the end of 1907 I determined to put this theory to the test. Up to that time the strength of salines generally advised in cholera was 0·6 per cent., although recent physiological text-books have raised the figure for normal saline to 0·85 per cent. As I wished to give a hypertonic solution—that is, one containing more salt than the normal blood—I doubled the former strength and used a 1·2 per cent. of sodium chloride, or 120 grains to a pint, to which I afterwards added 4 grains of calcium chloride, because physiologists have found the latter salt to be beneficial to the heart. Capt. (now Lt.-Col.) Mackelvie very kindly carried out the hypertonic injections on the cases under his care, while I made a series of observations on the blood, to be related presently. The results may be summarised in a sentence by saying that by using two teaspoonfuls of common salt to a pint of water instead of one, the mortality from cholera was nearly halved. Nothing could well be simpler, yet nearly eighty years had elapsed since salines were first injected intravenously in cholera before the physiological principle of using a hypertonic instead of an isotonic solution was established. It was at once clear to me that a great advance had been made, which stimulated me to persevere with my investigations of the blood-changes in cholera, so as to place the whole subject on a firm scientific basis.

The Blood-changes in Cholera as a Basis for the Hypertonic Treatment.

In the first place, I estimated the amount of chlorides in the blood before and after saline injections in a series of cases, and found that in the most severe cases they might even be below the normal point in spite of the great concentration of the blood, thus establishing a vicious circle and leading to further rapid loss of any isotonic solution injected into the veins. I further established that the hypertonic saline did materially raise the salt content of the blood, and to the greatest extent in recovering cases, which explained both the failure of the former isotonic and the success of the hypertonic solutions.

Another important point was to estimate the amount of fluid lost from the blood in cholera, so as to ascertain if the amount was in proportion to the severity of the case, and to learn how much salt solution it is necessary to inject to replace the loss. For this purpose I centrifuged a few drops of defibrinated blood obtained by pricking the finger-tip in a graduated capillary tube, and measured the volume of the solid corpuscles and of the fluid serum. By comparing the figures obtained with those of normal blood the percentage of fluid lost from the blood could be estimated. For example, in a severe case only 18 per cent. out of the original 55 per cent. of serum remained, showing a loss of no less than 67 per cent. of the fluid portion of the blood as a result of the copious evacuations. A series of such observations indicated that in mild cases of cholera not showing any serious collapse an average of 35 per cent. of the serum was lost; in collapse cases recovering after the hypertonic saline injections the loss averaged 52 per cent.; while in extremely severe cases, who were lost in spite of the new treatment, the figure averaged no less than 64 per cent., or almost two-thirds of the fluid of the blood. I have seen cases of cholera in which the blood was so thick that on opening a vein a drop of black blood slowly exuded having the consistency almost of tar—a condition which must rapidly terminate fatally if not quickly relieved. By repeating these estimations immediately after several pints of saline had been run rapidly into a vein in collapsed cholera cases, I was able to ascertain the quantities required to restore the

[1] From the presidential address delivered to the Indian Science Congress, Bombay, 1919, by Lt.-Col. Sir Leonard Rogers, F.R.S.

normal fluidity of the blood, and found them, as I had suspected, to be much greater in severe cases than had formerly been given when isotonic solutions were in use. The hæmocrite, however, is too much of a laboratory instrument to be generally available, so a simple bedside method was needed. I therefore made use of Lloyd-Jones's method of estimating the specific gravity of the blood by means of a series of solutions of glycerine in water in small labelled bottles into which small drops of blood are gently blown from a capillary tube, and that in which one just floats is noted, which gives the required estimation. Whenever the pulse tends again to fail, the test is repeated as a guide to further treatment, and in several extremely severe cholera patients more than thirty pints of fluid have thus been injected in the course of several days with ultimate success in saving the lives of the patients.

Permanganates and Other Drugs in the Treatment of Cholera.

The success of the hypertonic saline injections in enabling the collapse stage of cholera largely to be overcome opened the way to a trial of drug treatment such as had never before been possible; for it is clear that, unless the circulation can be restored and maintained, drugs given by the mouth will not even be absorbed, and can have no chance of exerting their beneficial action. Great care is required to make such tests trustworthy on account of the numerous sources of fallacy in estimating the effects of a given treatment. The best plan is to use a new drug in every other case in addition to the routine treatment, the remaining half of the cases then serving as a control. To take an example of this method of investigation, the late Sir Lauder Brunton some years ago advocated on physiological grounds the use of atropine in cholera, but was only able to try it in two mild cases with inconclusive results. I therefore gave the drug hypodermically in addition to the routine treatment in every other case of cholera in my wards for a whole year with the result that the mortality was much lower in the atropine series, while a careful comparison of the two sets of cases as regards their severity showed them to be strictly comparable. I have, therefore, added atropine to my system of treatment with, I am sure, beneficial results. In a similar manner emetine was found to be useless in cholera.

Another point I wish to emphasise is the importance of carefully studying one's failures rather than being elated with any success, as the further progress I have still to relate is mainly due to my adopting that practice. For the last ten years I have tabulated with the aid of shorthand—of the value of which in my work I cannot speak too highly—all the more important points of my cholera cases, now amounting to a little more than two thousand, and have closely studied the records of all fatal cases to ascertain the reasons for the failures with the view of finding means of lessening them. The following examples will illustrate some of the results thus obtained.

After an experience of a year and a half of the hypertonic treatment I realised that something more was required if the mortality was to be reduced still further. The failures appeared to me to be due largely to a recurrence of the collapse on account of absorption of the toxins produced by the cholera bacillus in the intestinal canal with the restoration of the circulation after the saline injections. Now the toxins are contained in the bodies of the innumerable bacilli, and set free when they break up, as they do in enormous numbers, for it has been shown that no fewer than 90 per cent. of comma bacilli die in culture-tubes within forty-eight hours. The use of intestinal antiseptics may very possibly add to the toxin absorption by killing the bacilli, which is, I believe, one of the reasons for their failure, as already stated. I therefore sought for some method of destroying the toxins themselves while still unabsorbed in the bowel; and, bearing in mind that they are largely albumoses and other unstable albuminous products of the metabolism of the organisms, and that such substances are readily destroyed or rendered inert by oxidisation, I experimented with various oxidising agents, and particularly with permanganates, which are well known to destroy rapidly *in vitro* the albumoses of snake venoms—a point at which I had previously worked. I was thus able to demonstrate that several times a lethal dose of dead comma bacilli containing the toxins could be neutralised by a small quantity of permanganates. A trial of large doses of permanganate of potash in pill form by the mouth, as much as one hundred grains sometimes being given in the course of several days, in addition to the hypertonic treatment, reduced the mortality of cholera during a year's use from 32·6 to 23·3 per cent., and it has now been used for more than nine years in my wards with increasingly favourable results. Permanganate pills have also been used in cholera epidemics in both the Bombay Presidency and the Central Provinces, in villages under conditions in which the saline treatment was not practicable, and favourable results have been reported, although, of course, it cannot by itself save the most severe cases with extreme collapse.

Alkalis in the Prevention of Fatal Renal Complications.

There still remained one very important line of investigation, which has recently led to a further substantial reduction of the death-rate of cholera by enabling the common and most deadly suppression of the renal function largely to be averted. I know of nothing more disheartening than, after successfully maintaining the circulation by hypertonic salines through a life-and-death struggle for several days and nights, to be unable to get the kidneys to resume their functions, with ultimate loss of the patient. As the losses from collapse were steadily reduced by the various measures I have related, the death-rate from kidney failure continued much the same, and now became the most important remaining cause of loss of life, and it was apparent that some factor remained which was not clearly understood.

Light was first thrown on this problem by an American physician, Dr. Sellards, working in the Philippines, who suspected a diminution in the alkalinity of the blood, or acidosis as it is generally termed, because he found that large doses of alkalis by the mouth failed to make the urine alkaline as it would do in health. He therefore added sodium bicarbonate to the saline solution used in cholera for intravenous injections, and obtained a marked reduction in the death-rate from renal failure. In 1911 Major Megaw, when acting for me in Calcutta, read Sellards's work, and tried alkaline solutions intravenously in cases of cholera with suppression of urine, but with disappointing results, the measure being apparently too late once this complication had become established. Early in 1912 I therefore commenced an investigation of the changes in the alkalinity of the blood in cholera, which Sellards had not then done, and finding an extreme degree of reduced alkalinity in all cases with fatal kidney trouble, with the help of Capt. Shorten, and later of Rai Satish Ch. Banerjee Bahadur, of the Physiological Department, I made a long series of such estimations in cholera cases, with the result of demonstrating that a very marked degree of diminution of the alkalinity of the blood occurred in all cholera cases, while once it reached the extreme degree of N/100 from a normal of about N/25 fatal

suppression of urine took place in spite of very copious alkaline injections. It thus became clear that in all severe cholera cases sodium bicarbonate should be added to the hypertonic saline solution as a routine measure to combat the acidosis from the first, and prevent it reaching a dangerous degree. The results of this addition to the treatment were soon apparent, and after three years' use of the alkaline solutions the death-rate from renal complication among nearly six hundred cases had fallen to 2·98 per cent. from a figure of 11·1 per cent. during the previous three years, or a reduction of 74 per cent. in the losses from this deadly complication, and the last remaining cause of death in cholera was thus largely conquered.

The Diminution in the Mortality of Cholera.

The results may be very briefly summarised in the following table, showing the mortality under the different forms of treatment, or rather the continued elaboration of my system of treatment with increasing knowledge derived from combined clinical and pathological investigations extending over twelve years, and culminating in a reduction of the mortality between 1895 and 1905, before I began work, of 59 per cent. to one of 19·1 per cent. between 1915 and 1917, or one-third of the former rate, while in 1917, among 208 cases, it was but 14·9 per cent., or one-fourth of the earlier figure, although all cases admitted moribund and dying before a saline injection could be given, thus coming late in a hopeless state from suppression of urine, and very young and very old persons without the stamina to allow the treatment to have a fair chance, are included. I therefore think it may fairly be claimed that cholera has now been robbed of most of its terrors by simple scientific investigation with the aid of physical methods in the use of the hæmocrite and specific gravity test, chemical research in the use of permanganates to destroy the toxins in the bowel, and alkalis to combat the deadly acidosis and physiological principles leading to the use of atropine and the all-essential hypertonic saline injections. More may yet be done, but sufficient has already accrued to prove the inestimable life-saving and economic value of medical research work, and to encourage both administrative authorities and philanthropists to look on liberal expenditure on medical research as the best possible use of public and private money.

Table of Cholera Mortality under Different Methods of Treatment.

Years	Cases	Deaths	Mortality, per cent.	Recoveries per cent.
Normal Saline subcutaneously and per rectum.				
1895 to 1905 ...	1243	788	59·0	41·0
Normal Salines intravenously.				
1906	112	57	51·9	49·1
Normal Saline subcutaneously and per rectum.				
1907	158	94	59·5	40·5
Hypertonic Salines intravenously.				
1908 to 7–1909 ...	294	96	32·6	67·4
Hypertonic Salines *plus* Permanganates.				
8–1909 to 1914 ...	858	222	25·9	74·1
Hypertonic Salines, Permanganates, and Alkalis.				
1915 to 1917 ..	638	122	19·1	80·9

The Future of Medical Research in India.

The great lesson to be derived from the researches on cholera which I have related is the importance of combined clinical and pathological investigations. So strongly do I hold the necessity of medical research workers being in the closest possible relationship with large hospitals to enable them to work on practical lines that I regard Pasteur's great discovery of his preventive treatment of hydrophobia as having been a curse rather than a blessing to India, because it has led to three important research laboratories being placed on remote hilltops for the sake of the relatively insignificant mortality from hydrophobia, to the grave detriment of work on all the more important tropical diseases. Now that the treatment of hydrophobia and other bacteriological methods can be carried out in the plains with the help of a refrigerator, as is being done at the present time in Rangoon, no excuse for further repetitions of this grave mistake remain.

The serious disadvantage which so many of the members of the bacteriological—or, as it should be called, medical research—department now labour under by their divorce from large hospitals in the plains will be partly removed when the schools of tropical medicine in Calcutta and Bombay are opened, when team-work so essential to the solution of the larger medical problems will be possible. In addition, all the larger hospitals should have whole-time pathologists, to enable the abundant clinical material they contain to be made available for research purposes, and also to allow the clinical staff and the patients to have the immense advantages in the diagnosis and vaccine and other lines of treatment which a bacteriological laboratory affords through recent advances in our knowledge of medicine. For example, fevers and dysentery are the two great causes of disease and death in India, but it is only with the help of microscopical examinations that they can be rapidly diagnosed and efficiently treated, and without this aid even the most experienced physicians too often cannot do full justice to their patients. In future, I understand pathologists of our medical colleges will be supplied from the bacteriological or research department, and will make the subject their life-study, and not be eligible for clinical posts. In order to get the medical officers with the highest abilities and scientific training required for success in research to devote their lives to it, and to abandon the much more lucrative clinical side of medicine, it will be absolutely necessary to give them salaries in proportion to the long and expensive scientific training of from six to eight years which they receive after finishing their general school education.

Now that the war has led to careful inquiries into scientific education in Great Britain, and a greatly increased demand for men of science at home, the difficulty in recruiting those required for industrial and educative progress in India will be much greater than hitherto, while it will be still further enhanced by the uncertainty of the prospects of young men coming to India for their life's work in Government service due to the proposed ten-yearly kaleidoscopic changes in the constitution of this country. I have felt it to be my duty to point out the rocks ahead in this direction, and to indicate the absolute necessity for much more generous treatment in the immediate future of men of science of all branches of knowledge required for service in India.

The Need for Liberal Endowments of Medical Research in India.

Lastly, I wish to direct attention to the great life-saving and economic importance of such investigations as those which I have related on cholera, and many others which might be mentioned; as when this is fully realised by the public, endowments of medical research will surely be forthcoming in India on a far larger scale than hitherto. Bengal and Bihar have generously given me seven lakhs for the Calcutta School of Tropical Medicine, half of which has been expended on the Carmichael Hospital for Tropical Diseases, and the remainder will be used for medical research and the partial upkeep of the hospital under

a governing body of medical experts. In addition, the Tea, Jute, and Mining Associations are contributing 60,000 rupees a year for the support of three additional workers to investigate on practical lines those diseases which affect the value of the labour forces. Bombay has always been noted for the liberality of her citizens, so I confidently appeal to this great city to do at least as much for my friend Col. Liston's school here, which he has laboured so long and patiently to found in connection with the Parel Laboratory.

Now that the world-wide devastation and the destruction of irreplaceable human life have at length ceased, I should like to see the flow of money diverted to the noble object of saving life by means of a great extension of medical research, and I can conceive of no more fitting thank-offering for the delivery of the world from the greatest menace that has ever threatened modern civilisation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—The Council of the University has approved of the representation of the non-professorial members of the teaching staff on the faculties, the representatives to be elected by the non-professorial members. Hitherto this privilege has been confined to the faculty of medicine, but it is now to be extended to the other faculties. It is proposed that there shall be three representatives on the faculty of science and two on the faculty of arts.

Cambridge.—The question as to whether the University is prepared to accept financial assistance from the Government under the conditions laid down in Mr. Fisher's letter, referred to last week (p. 229), will be submitted to the Senate on May 31, when the following grace will be offered:—That (1) the Vice-Chancellor be authorised to inform Mr. Fisher that the University would welcome a comprehensive inquiry into its financial resources instituted by the Government, and give every assistance in its power; and (2) pending such inquiry the Vice-Chancellor be requested to draw the attention of the Government to the pressing need for an emergency grant.

The Goldsmiths' Company has agreed to give a sum, not exceeding 5500*l.*, to the University for the purpose of extending and equipping the department of metallurgy. The Goldsmiths' readership in metallurgy was founded by the company in 1908, and Mr. C. T. Heycock was appointed reader. The metallurgical department was at first housed in two rooms in the chemical laboratory, but the number of students rapidly increased, and when the department of agriculture left the chemical laboratory in 1910, Sir William Pope assigned the rooms thus vacated to metallurgy. The Goldsmiths' Company most kindly contributed the sum of 800*l.* for the alteration and equipment of these rooms. Furnaces, muffles, and high-temperature recording apparatus were installed, as well as the necessary assay and other balances. In addition, the apparatus used by Messrs. Heycock and Neville in their work on alloys was moved from their private laboratory into the new rooms, which thus became provided with a complete photomicrographic equipment. The number of students working at metallurgy has now increased beyond the capacity of the present laboratory, and the generous gift of the Goldsmiths' Company will provide a new analytical laboratory, with benches supplied with compressed air and high- and low-voltage direct current, a balance room, and also a room for general galvanometer and photographic work, with gas furnaces round the walls. Accommodation for sixteen students working at assaying and general mineral analysis and for ten research students will thus become available.

Mr. R. I. Lynch, who has been curator of the University Botanic Garden since 1879, has resigned his office on medical grounds. Before coming to Cambridge Mr. Lynch had held the post of senior foreman at Kew. Under his care the Botanic Garden has played a most important part in the University teaching, and the University showed its appreciation of his scientific work by conferring upon him in 1906 the honorary degree of M.A. His devotion to the welfare of the garden, and his readiness to assist all who made demands upon his unrivalled knowledge, have gained for him the respect and affection of many friends, and his departure from Cambridge will be greatly regretted.

Oxford.—Notice is given of the forthcoming election to a tutorial fellowship at Exeter College for the teaching of chemistry. Applications must be sent to the Rector of the college by June 10. The fellowship is of the annual value of 200*l.*, *plus* certain allowances.

Government grants to University institutions in Oxford have hitherto been limited in amount, and confined to one or two departments which were doing work of special importance to the Government. The question of larger subsidies has now been raised, partly on the initiative of the Government itself. Reluctance has always been felt by many in Oxford to seek pecuniary aid in this manner, from the apprehension that it might lead to the sacrifice of academic independence. It is certain that no grant would be given without a comprehensive inquiry into present resources and the use being made of them, and it remains to be seen whether the prospect of much-needed financial assistance will outweigh the dislike of interference with the autonomy so much prized by a large number of members of the University.

The Halley lecture was delivered by Prof. Horace Lamb at the University Museum, on May 20, before a large and appreciative audience. In dealing with the subject of the tides, Prof. Lamb directed attention to the discrepancy between the theoretical outcome of calculation and the actual phenomena experienced, pointing out that the equilibrium theory is a theory of tidal forces, not of their results. The method of computation originated by Kelvin and George Darwin, known as the method of harmonic analysis, rested on a combination of theory and observation. It was suggested some fifty years ago that the tides might give some idea of the rigidity of the globe as a whole. Kelvin pointed out that if the interior of the earth were fluid, tides would occur internally. Pendulum experiments had shown, by deflection of the plumb-line, that the earth does yield somewhat to tidal influence. Its rigidity is about equal to that of a globe of steel.

Dr. Gisbert Kapp is about to resign the professorship of electrical engineering in the University of Birmingham.

Mr. W. Thomson, hitherto head of the physics department of Battersea Polytechnic, has been appointed principal of the Croydon Polytechnics.

Dr. H. Pringle, lecturer on histology in the University of Edinburgh, has been appointed to succeed

the late Sir Henry Thompson in the chair of physiology in Trinity College, Dublin.

APPLICATIONS will be received until June 28 by the British Medical Association, 429 Strand, for an Ernest Hart memorial scholarship, value 200*l.* per annum, for the study of some subject in the department of State medicine, and for three annual research scholarships, each of the value of 150*l.*, for research in some subject relating to the causation, prevention, and treatment of disease.

CAPT. EUSTACE H. CLUVER has been appointed to the new chair of physiology at the South African School of Mines and Technology at Johannesburg. Capt. Cluver went as a Rhodes scholar to Hertford College, Oxford, in 1914, and took a First Class in the Final Honour School of Physiology in 1916. After a varied medical experience he went out to the front with the South African Medical Corps, where he was engaged until the time of the armistice.

THE following munificent benefactions towards the cost of developing the work of the Imperial College of Science at South Kensington are announced:—Mr. Otto Beit, a member of the governing body, has placed at the disposal of the governors the sum of 10,000*l.*, to be used for building and equipment purposes for such departments of the college as may be found most urgently to require assistance for development; and an old student of the Royal College of Science has contributed a sum of 8000*l.* for the equipment of an intermediate-scale laboratory in organic chemistry, a new building for which is now in course of erection.

THE eighth annual meeting of the Old Students' Association of the Royal College of Science, London, was held on May 24, Prof. H. E. Armstrong presiding. A resolution was adopted appointing a special committee to consider and report on the reorganisation of the association to an adjourned meeting to be held in October. Sir Richard Gregory was elected president for 1919. A discussion took place on the question of raising the status of the Imperial College to that of a university, in the course of which Mr. T. Ll. Humberstone, secretary of the association, expressed strong opposition to the proposal, which, he considered, would entail endless friction, as well as disorganisation and duplication of effort. The annual dinner was held in the evening at the Café Monico.

AN invitation has been sent by the Chief of the Imperial General Staff to the universities and other institutions of higher education to nominate representatives to a conference on June 11 and 12 with representatives of the Dominions, to discuss educational problems that have presented themselves to the Imperial Education Committee of the War Office as a result of experience gained in the working of the educational schemes within the British Army and the Forces of the Dominions. The conference will be held in Australia House. The Chief of the Imperial General Staff will preside at the opening session, when an address will be given by Mr. Fisher, President of the Board of Education. Lord Milner, Sir Henry Hadow, and Sir Daniel Hall will preside at subsequent sessions, when reciprocity between the universities of the Empire in the organisation of study and research to meet the technical, commercial, and agricultural needs of the Empire will be discussed. Sir Henry Hadow has relinquished the post of Assistant Director of Staff Duties (Education), and Mr. P. A. Barnett, formerly Chief Inspector of Training Colleges, has been appointed Civil Adviser to the Educational Department of the Staff Duties Directorate, War Office.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 15.—Sir J. J. Thomson, president, in the chair.—Prof. W. H. **Young**: (1) The area of surfaces. Many attempts by well-known writers have been made to frame a theory of the area of surfaces. These efforts have been attended with so little success that even the most recent text-books define the area of a curved surface by means of the formula known to hold in the case of a surface of revolution. Not even in the matter of the definition itself has anything which can be regarded as final been achieved, still less has it been found feasible to proceed from the definitions which have been given to the formula required. In the present communication the author attacks the question from an entirely new point of view. The definition given is based on what is itself a new concept, namely, that of the area of a closed skew curve. It is characterised further by the use to which is put the idea that the surface is, like a curve, an ordered manifold, the order being double instead of single. The surface is accordingly supposed defined by equations of the form

$$x=x(u, v) \qquad y=y(u, v) \qquad t=t(u, v)$$

and divided up by the curves

$$u=\text{const.} \qquad v=\text{const.}$$

On the fact that the sum of the areas of the boundaries of the portions of surface thus obtained has a unique limit, the definition of the area of a surface is based. The curve boundaries have, in fact, an area whenever they possess a length. Moreover, the unique limit obtained for their sum is shown under very general conditions to have precisely the value given by the well-known formula. (2) Change of the independent variables in a multiple integral.—Prof. W. A. **Bone** and R. J. **Sarjant**: Researches on the chemistry of coal. Part i.: The action of pyridine upon the coal substance. The paper records the results of an experimental investigation of the so-called solvent action of pyridine and homologues upon the coal substance, with the double object of clearing up certain discrepancies in the work of previous investigators and of determining the real nature of the action in question. It is shown that the presence of oxygen has an important retarding action upon the extraction process (the extent of which varies considerably with the nature of the coal), and that in order to obtain consistent results in any such process it is necessary not only to employ an anhydrous solvent, but also to exclude oxygen. The application of the method to two typical isomeric bituminous coals is fully described. It is shown that when such extraction is carried out at ordinary pressures, with exclusion of oxygen, a practical limit is finally attained. In the case of the two coals in question, this limit considerably exceeded the amount of "volatiles" yielded by them on carbonisation at 950°. At higher pressures this first limit was considerably passed, and when conducted in sealed tubes between 130° and 150° as much as two-thirds of the coal substance was rendered soluble.—Prof. E. F. **Burton**: A new method of weighing colloidal particles. When fine colloidal particles are dragged up and down for equal periods in a liquid by the application of a vertical electrical field a net settling of the particles is noted. It is thought that, though for small forces such as gravity alone the Brownian movement prevents the attainment of any limiting velocity, yet when the particles are dragged by a much larger force the comparatively insignificant gravitational force is added to the electrical for downward motion and subtracted for upward motion, thus becoming effective in producing a net

settling of the particles. Application of Stokes's law to this net settling gives a value for the size of the particles very closely agreeing with that obtained by the counting method (*e.g.* $2\cdot2\times10^{-5}$ cm. and $1\cdot7\times10^{-5}$ cm.), even though values to hand are taken from old observations made when this net settling was not appreciated and not closely observed. Experiments are now in hand to determine this settling very exactly.—W. E. **Curtis**: The value of the Rydberg constant for spectral series.

Royal Meteorological Society, May 21.—Sir Napier Shaw, president, in the chair.—Capt. C. J. P. **Cave** and J. S. **Dines**: Further measurements on the rate of ascent of pilot-balloons. The paper discusses experiments made, in continuation of previous work, on the rate of ascent of pilot-balloons measured in a closed building. The building used in the present case was the Royal Albert Hall, which is very suitable for the purpose, inasmuch as a clear height of 40 metres is available from floor-level to the grid at the centre of the domed roof. The formula in general use in this country for the rate of ascent is, rising velocity $V=q\sqrt{L}/\sqrt[3]{W+L}$, where L=the free lift and W the dead-weight of the balloon, and q is a constant the value of which is to be determined under different conditions. It had previously been suggested that the value of q varied with different degrees of loading of the balloon. Attention was directed to this question, and quantitive results were obtained. Measurements were also made with a candle-lantern of the pattern used for night ascents hung below the balloon. It was found that this produced no effect upon q. In timing the rate of ascent in closed buildings a fine thread has generally been attached to the neck, and has been drawn up from the floor as the ascent proceeded. In the present case experiments which were made with and without such a thread showed that some correction is necessary where a thread is used. The general results confirmed the value $q=84$, which is used at the present time, for balloons of the size generally adopted for pilot-balloon work. This value gives velocities in metres per minute when lift and dead-weight are expressed in grams.—J. Edmund **Clark** and H. B. **Adames**: Report on the observations for the phenological year, December, 1917, to November, 1918. The excessive cold of December, 1917, was followed by three mild months, February in particular. Hence by April 1 blackthorn was in most parts blooming, whereas after the very cold early months of 1917 the mean date was thirty-five days later than in 1918. Rarely has the farm and garden promise at this date been so satisfactory. Then came the mid-April bitter weather, disastrous to the opening fruit-tree buds, and a continuation of summer drought and coolness continued the prejudicial conditions. A genial August greatly favoured the earlier harvesting districts, but the excessive wet in September caused damage and loss elsewhere. The whole autumn was cool, but comparative dryness in October and November helped finally in the harvesting of nearly average field crops. Potatoes gave a record for acreage and yield per acre, but after storage there was serious loss from disease. The migrant records support the interesting weather relationships shown by the other tables. The April cold delayed the appearance of the sixteen earlier birds two or three days more than the other ten. The isophenal lines on the map indicate the districts where the plants of Table III. blossomed simultaneously. Their course shows the marked influence of elevation. On the same map are also shown the isotherms for the first half of the year, and a comparison of these with the isophenes is a matter of considerable interest.

Paris.

Academy of Sciences, May 5.—M. Léon Guignard in the chair.—A. **Lacroix** and A. **de Gramont**: The presence of boron in some natural basic silico-aluminates. A spectroscopic examination of saphirine, kornerupine, and grandidierite showed that boron had been overlooked in the analyses. In the order named there were present 0·75 per cent., 3·59 per cent., and 2·81 per cent. of boric anhydride. The boron may be considered as replacing aluminium isomorphically in these minerals. The results of the spectroscopic examination of other minerals for boron are given.—H. **Deslandres**: Remarks on the constitution of the atom and the properties of band spectra. A discussion of the formulæ expressing the general structure of band spectra, with reference to the various hypotheses on the composition of the atom.—C. **Depéret**: An attempt at the general chronological co-ordination of the Quaternary epoch.—Ed. **Imbeaux**: The navigable waterways of Alsace and Lorraine. An account of the actual position of water-carriage in these provinces and the modifications which they will want in the immediate future to meet the industrial requirements, including the transport of coal from the Saar basin, oil from Pechelbronn, iron from the Lorraine mines, potash from Mulhouse, soda salts, cements, and other industrial products.—M. **Defourneaux**: Some properties of electro-spherical polynomials.—G. **Julia**: Uniform functions with an isolated essential singular point.—G. **Guillaumin**: Certain particular solutions of the problem of sandy flow where the massif considered comprises two regions governed by different laws.—Ed. **Urbain** and C. **Scal**: The decomposition of dielectric liquids surrounding an arc. It was necessary to use metallic electrodes in these experiments, as the separated carbon then remained in suspension in the liquid. If the liquid is maintained at 15°, the decomposition products are different from those obtained when the liquid is allowed to boil. Some particulars of experiments with tin tetrachloride, titanium tetrachloride, carbon tetrachloride, some hydrocarbons, and ketones are given.—A. C. **Vournasos**: The normal nitrides of nickel and cobalt. If nickel cyanide is heated with nickel oxide to a temperature not exceeding 1000° C., the only products of the reaction are carbon monoxide, nitrogen, and metallic nickel. If, however, these two substances are rapidly heated to more than 2000° C., the products are carbon monoxide and nickel nitride, Ni_3N_2. The corresponding cobalt nitride is formed in a similar reaction.—A. **Kling** and R. **Schmutz**: The estimation of traces of carbonyl chloride in air. The air is passed through aqueous aniline, and the diphenylurea formed by the phosgene determined either by weighing or by conversion into ammonia. For quantities varying from 0·22 to 0·44 milligram of $COCl_2$ per litre the error averaged 5 per cent. of the amount present.—M. **Picon**: The action of the monosodium derivative of acetylene upon some primary alkyl iodides with branched chains.—E. **Fleury**: The signification and *rôle* of *lapiesation* in the disaggregation of granitic rocks in Portugal.—G. **Guilbert**: The prediction of barometric variations.—P. **Thiéry**: New observations on the system of geological accidents called the *Faille des Cevennes*.—L. **Léger** and E. **Hesse**: A new parasitic Coccidium of the trout. This new species, for which the name *Goussia truttae* is proposed, has been observed in wild trout from the neighbourhood of Grenoble. A full description is given.—S. **Stefanescu**: The co-ordination of the morphological characters and of the movements of the molars of elephants and mastodons.—R. **Fosse**: The simultaneous oxidation of blood and glucose. Urea is produced by this oxidation.—G. **Bertrand** and Mme. M.

Rosenblatt: The comparative toxic action of some volatile substances upon various insects. The comparative effects of the vapours of ether, chloroform, carbon bisulphide, carbon tetrachloride, monochloroacetone, benzyl bromide, chloropicrin, and prussic acid upon the larvæ of *Bombix neustria* have been studied. Chloropicrin proved to be the most toxic.

BOOKS RECEIVED.

Dr. John Fothergill and his Friends: Chapters in Eighteenth-century Life. By Dr. R. H. Fox. Pp. xxiv+434. (London: Macmillan and Co., Ltd.) 21*s*. net.

The Geographical Part of the Nuzhat-al-Qulūb. Composed by Hamd-Allāh Mustawfī of Qazwīn in 740 (1340). Translated by G. Le Strange. "E. F. W. Gibb Memorial" Series. Vol. xxiii., No. 2. Pp. xix+322. (Leyden: E. J. Brill; London: Luzac and Co.) 8*s*.

L'Origine des Formes de la Terre et des Planètes. By E. Belot. Pp. xii+213+iii plates. (Paris: Gauthier-Villars et Cie.) 14.40 francs net.

The Intuitive Basis of Knowledge: An Epistemological Inquiry. By Prof. N. O. Lossky. Translated by N. A. Duddington. Pp. xxix+420. (London: Macmillan and Co., Ltd.) 16*s*. net.

Industrial Chemistry. By Dr. C. Ranken. Pp. 126. (London and Edinburgh: T. C. and E. C. Jack, Ltd., and T. Nelson and Sons, Ltd.) 1*s*. 3*d*.

A Geography of America. By T. Alford Smith. Pp. x+329. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*.

A Vision of the Possible: What the R.A.M.C. Might Become. By Sir J. W. Barrett. Pp. xx+182. (London: H. K. Lewis and Co., Ltd.)

Elements of Graphic Dynamics. By E. S. Andrews. Pp. viii+192. (London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Animal Life and Human Progress. Edited by Prof. A. Dendy. Pp. ix+227. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

The People's Health. By W. M. Coleman. Reprint. Pp. xi+370. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

Productive Agriculture. By Prof. J. H. Gehrs. Pp. xii+436. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Manual of Lip-reading. By Mary E. B. Stormonth (Mrs. F. H. Mann). Pp. ix+208. (London: Constable and Co., Ltd.) 5*s*. net.

The Essentials of English Teaching. By Members of the English Association. Pp. 11. (London: Longmans and Co.) 1*s*.

The Peace Conference Atlas. Maps 24. (London: E. Stanford, Ltd.) 5*s*.

DIARY OF SOCIETIES.

THURSDAY, MAY 29.

INSTITUTION OF ELECTRICAL ENGINEERS, at 2.30.—Annual General Meeting.
ROYAL INSTITUTION, at 3.—Sir Valentine Chirol: The Balkans.
ROYAL SOCIETY, at 4.30.—Croonian Lecture—Dr. H. H. Dale: The Biological Significance of Anaphylaxis.
ROYAL AERONAUTICAL SOCIETY, at 8.—Squadron-Commander G. M. Dyott: Flying in South America.

FRIDAY, MAY 30.

ROYAL INSTITUTION, at 5.30.—Sir John R. Bradford: A "Filter-passing" Virus in Certain Diseases.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Discussion resumed by Dr. W. Rosenhain on Paper by Dr. W. H. Hatfield: The Mechanical Properties of Steel, with some consideration of the Question of Brittleness.
ILLUMINATING ENGINEERING SOCIETY, at 8.—F. W. Willcox: The Gas-filled Lamp and its Effect on Illuminating Engineering.

SATURDAY, MAY 31.

BRITISH PSYCHOLOGICAL SOCIETY, at 3.30.—F. E. Bartlett and Miss E. M. Smith: Listening to Sounds of Minimal Intensity.—E. Bullough: The Relations of Æsthetics to Psychology.

MONDAY, JUNE 2.

VICTORIA INSTITUTE, at 4.30.—E. Walter Maunder: The Mosaic Calendar as a Means of Dating approximately certain Ancient Writings.
SOCIETY OF ENGINEERS, at 5.30.—A. Stewart Buckle: Re-settlement of Officers in Civil Life.—T. J. Gueritte: The Unknown Versailles.
ARISTOTELIAN SOCIETY, at 8.—Very Rev. Dean W. R. Inge: Platonism and Human Immortality.
SOCIETY OF CHEMICAL INDUSTRY, at 8.—Informal Meeting.

TUESDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—Prof. W. H. Bragg: Listening under Water.

WEDNESDAY, JUNE 4.

GEOLOGICAL SOCIETY, at 5.30.—A. Smith Woodward: The Dentition of the Petalodont Shark, Climaxodus.—F. Debenham: A New Theory of Transportation by Ice: the Raised Marine Muds of South Victoria Land (Antarctica).

THURSDAY, JUNE 5.

ROYAL INSTITUTION, at 3.—Sir Valentine Chirol: The Balkans.
ROYAL SOCIETY OF ARTS, at 4.30.—Lord Montagu of Beaulieu: Aviation as Affecting India.
CHEMICAL SOCIETY, at 8.—W. H. Perkin: Cryptopine. Part II.—P. Blackman: An Isotonic (Isosmotic) Apparatus for comparing Molecular Weights. Part I.—V. Cofman: The "Active Substance" in the Iodination of Phenols.—N. V. Sidgwick: The Influence of Orientation on the Boiling-points of Isomeric Benzene Derivatives.—J. Senior: The Atomic Weight of Iodine, and the Discovery of a New Halogen.—H. Hepworth: The Absorption Spectra of the Nitric Esters of Glycerol.

FRIDAY, JUNE 6.

ROYAL INSTITUTION, at 5.30.—Sir E. Rutherford: Atomic Projectiles and their Collisions with Light Atoms.

SATURDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—J. M. Price: The Italian Front.

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THURSDAY, JUNE 5, 1919.

INDUSTRIAL EFFICIENCY.

(1) *The Human Machine and Industrial Efficiency.* By Prof. F. S. Lee. Pp. viii+119. (New York and London: Longmans, Green, and Co., 1918.) Price 5*s.* net.

(2) *The New Physiology, and Other Addresses.* By Dr. J. S. Haldane. Pp. viii+156. (London: Charles Griffin and Co., Ltd., 1919.) Price 8*s.* 6*d.* net.

(1) DURING the last few years the importance of the scientific study of industrial efficiency and fatigue has gradually become more and more recognised, and Prof. Lee's book on the subject comes at a very opportune moment. Prof. Lee speaks with authority, not only by reason of his physiological investigations on fatigue, but also because of the inquiries which he and his colleagues have recently been making into the efficiency and fatigue of certain of the munition workers of the United States. The book does not aim at a complete presentment of the subject, but summarises the main conclusions which should be drawn in the light of recent research. These conclusions are very clearly stated in non-technical language, and it is to be hoped that the book will find its way into the hands of many captains of industry in this country as well as in America. A careful study could not fail to impress them with the practical importance of the subject, for it is one which concerns the employer no less than the employed.

Prof. Lee claims that the efficiency of the worker must be studied on lines dictated by physiological principles, and that a science of industrial physiology must be developed in which the laboratory for investigation is chiefly the factory and the workshop. Here, by suitable observation and experiment, it will be possible to ascertain, for instance, the length of the working day which offers the best conditions for maximum production in various industries. The evidence so far available points to the eight-hour day as being the most suitable in many types of labour, but this period does not necessarily apply to other industries in which the conditions of work have not been investigated. Other inquiries are being made into the suitability of workers for different types of work, and the physical strength of various groups of munition workers has been determined by exact tests. It may surprise some of those who suggest the equality of men and women in industry to learn that the average industrial woman has less than half the strength of the average industrial man. Other chapters in the book deal with rest periods, overtime, accidents, night work, and the welfare and feeding of the worker. Again, the question of "scientific management" is debated, and its excellences and defects are pointed out. It will be evident, therefore, that the book touches on all the main questions relating to industrial efficiency.

(2) In "The New Physiology" Dr. J. S. Haldane has collected six addresses which have been delivered by him during the last few years before the British Association and other learned societies. They deal, for the most part, with his views on mechanistic and vitalistic hypotheses of physiological processes and of the constitution of living matter. He maintains that physical and chemical explanations cannot be accepted, even as a working hypothesis, and he regards them as "probably the most colossal failure in the whole history of modern science." He is likewise unable to accept the existence of a specific vital force, but he propounds other views the tenor of which may be gathered from a few quotations. "The structure and activity of an organism are no mere physical structure and activity, but manifestations of life." Again: "The idea of life is just the idea of life. One cannot define it in terms of anything simpler, . . . but each phenomenon of life, whether manifested in 'structure,' or in 'environment,' or in 'activity,' is a function of its relation to all the other phenomena. . . . Life is a whole which determines its parts."

Dr. Haldane rightly points out that a living organism forms itself and keeps itself in working order and activity. It always tends to maintain a "normal" condition, though subjected to considerable differences of environment, such as the composition of the food it feeds on and the air it breathes. But wherein do these views, and those just quoted, constitute a "New Physiology"? It seems improbable that they have sufficient novelty of outlook and value as a working hypothesis to induce physiologists to renounce what Dr. Haldane admits to be still the orthodox mechanistic creed.

In an address on the relation of physiology to medicine Dr. Haldane urges the importance of our regarding physiology, anatomy, pathology, and pharmacology as the future basis of practical medicine. He points out that if medicine is not grounded on these sciences it is bound to become more and more an anachronism. The preliminary sciences must guide the medical man at every step, and their investigation must not merely be relegated to special laboratories, but be prosecuted at the bedside.

SOLAR THERMODYNAMICS.

A Treatise on the Sun's Radiation and other Solar Phenomena in Continuation of the Meteorological Treatise on Atmospheric Circulation and Radiation, 1915. By Prof. Frank H. Bigelow. Pp. ix+385. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 23*s.* net.

PROF. BIGELOW'S treatise is a work to approach with circumspection. On p. 245 we read: "The formulas of chap. i. should be kept continually in mind, especially in respect of the fact that no term can change without drawing

with it the entire long train of physical terms that are united with it." As there are already ninety-one formulæ when the end of chap. i. is reached, and they are, to say the least, of controversial application, those who are not looking for trouble may be disposed to pass by on the other side. One recalls the "great text in Galatians, Once you trip on it entails, Twenty-nine distinct damnations, One sure if another fails." But such a pusillanimous attitude is not permitted to a reviewer. He has to make up his mind whether the compressed mass of 117 tables and 380 formulæ which the book contains do in fact add light or darkness to the problems of the sun.

The book is a discussion, a contribution to theory; the observations upon which it is based are chiefly those of Mr. Abbot, with the pyrheliometer, but Prof. Bigelow contends that Mr. Abbot's results are erroneously reduced, so that whereas Mr. Abbot concludes a rise of intensity of solar radiation from 1·50 calories per square centimetre at sea-level to 1·94 at the confines of the earth's atmosphere, Prof. Bigelow, using the same observations, says that the latter figure should be raised to 3·98 calories. On p. 376 he remarks: "There is probably no apparatus more difficult to interpret correctly than is the pyrheliometer, because it demands a full knowledge of radiation in gases, in glass, in mercury, in metals, during variable transformations, in which the kinetic, potential, expansion, and free-heat energies are all undergoing mutual readjustments." One may well say so, if doctors disagree to that extent. On p. 210 is a *résumé* of the results of twelve different lines of computation, every one of which gives values between 3·92 and 4·08. This would naturally be very impressive, and one would wish to confirm it by recalculating a few of the numbers. But they are not of the kind that admits of this. One must accept them from the author, and without questioning at all their correct derivation from his formulæ, it must be said these formulæ are of a kind to give one most serious pause. They are, indeed, put forward as revolutionary. On p. 1 we read: "In the Boyle-Gay Lussac Law, $P = \rho RT$, all the terms, including the gas efficiency R, are variable." But if R is not constant, all accepted gas theory, and a great deal of the structure of general physics, tumble down in ruins. On p. 17 is given a list of quantities which must also be variable; they include among them the number of molecules per unit mass of any gas. On p. 129 we read: "The entire thermodynamics of radiation must be based upon a series of non-adiabatic variable coefficients, instead of a set of adiabatic constants, as has been assumed in previous discussions." It cannot be expected that we should make such a change without the most imperative reasons and the most direct and exhaustive proofs of its necessity. But these are wanting. The reasons given in two or three sentences, on p. 16, are certainly not convincing or inevitable. The accepted gas theory is not inadequate to explain, for example, isothermal strata in the earth's atmosphere. But Prof. Bigelow's new doctrine occupies his field of view so exclusively that the whole of his book, upon which immense labour must have been spent, stands or falls with it.

R. A. S.

OILS, FATS, AND WAXES.

Technical Handbook of Oils, Fats, and Waxes. By P. J. Fryer and Frank E. Weston. Vol. ii. "Practical and Analytical." (The Cambridge Technical Series.) Pp. xvi+314. (Cambridge: At the University Press, 1918.) Price 15s. net.

THE events of the last four years have directed attention to the economic importance of the edible oils and fats, and also to that of fats in general, as being the source from which glycerin is obtained. The national value of the industry which deals with these products is now pretty widely recognised. Fundamentally it is a chemical industry, and a knowledge of the chemistry of the oils, fats, and waxes will tend to become more and more desirable for those who control it on the technical side.

Messrs. Fryer and Weston may fairly claim to have assisted in the spread of such knowledge. In an earlier volume they have described the general chemistry of the oils, fats, and waxes, and the general principles of the methods of analysis used in the examination of these products. The present work is concerned with the practical application of those principles. It appears to be largely intended for technical chemists, but students are also within its purview. Of this we are reminded every now and then by the italicised note: *"Students should cleanse all apparatus in hot soft soap solution. . . ."* One seems to remember those students!

Both classes of users will find the volume very helpful. All the usual methods of analysis are described, with recent improvements and developments, and there are plenty of practical hints and notes.

The earlier parts of the book "begin at the beginning" with descriptions of apparatus and methods of manipulation, whilst the important matter of proper sampling receives due attention. In explaining the "standard" analytical determinations, the general plan adopted is to start with a definition, give a short outline of the method, offer remarks upon it, and describe the apparatus and materials required, before going on to the actual experiments. The directions are categorical, and are couched in a mood which may be characterised as the abbreviated imperative: "Dissolve dry fatty acids . . . decant off alcohol . . . distil off ether." A number of photographs of apparatus are included in the text.

Among the best and most important of the sections is the one which deals with the interpretation of the results obtained in the analyses. It is one thing to be able to carry out experiments on oils, fats, and waxes; it is quite another to know what the results really indicate. The authors discuss this question in some detail. They

point out how the same product may vary through differences of climate, feeding, methods of refining, and so on; and they then show by examples what deductions may legitimately be drawn from the experimental data.

The substances dealt with include hydrocarbon oils and waxes, rosin, turpentine, soap, glycerin, and candle material, as well as the animal and vegetable oils, fats, and waxes. The book appears to be well "up to date," and can be recommended as a very useful addition to the technical chemist's library. C. S.

OUR BOOKSHELF.

Joys of the Open Air. By William Graveson. Pp. 115. (London: Headley Bros., Ltd., n.d.) Price 3*s*. 6*d*. net.

To the town-dweller who has a longing for the countryside, more especially in the dull, damp early months of the year, when spring seems so long in coming, the chapters of this little book will serve as a tonic. Mr. Graveson is a man who loves his garden and his bird-visitors, as well as the meadows, woods, and chalk-downs beyond; he has eyes that can see, and above all he has the faculty of expressing what he sees and feels in simple, charming language.

In this delightful little volume he has jotted down some of his experiences during the months from February to September of last year. He shows how, when exactions of business and various duties curtail hours of recreation, and difficulties of travel prevent holidays from being taken far afield, there are opportunities for seeking new pleasures in familiar surroundings. The rambles described in his book have been in the compass of a half-holiday walk and not more than five miles of a country town within easy distance of London. The arrangement is chronological. Chap. i., "The Haunt of the Kingfisher," describes a bright morning early in the year when the hoarfrost lies thick on the common. "The Promise of Spring" (chap. ii.) recalls the coming of the winter aconite, the crocus, and other harbingers of spring. "The Incoming of Spring" is an epic of a sunny Palm Sunday—daffodils and scillas are out in the garden, a silky-coated Pasque-flower is preparing for its Easter display, and a bright red anemone for the warm April days; and never have the almonds looked more beautiful. And so on through the book to "Foxgloves and Fairies" and "The Lure of the Heather," which are the headings of the two last chapters.

The illustrations, photographic reproductions—a stream choked with water-violet, a bed of winter aconites, a cowslip meadow, and a few others—add to the charm of this series of Nature pictures.

Submarine and Anti-Submarine. By Sir Henry Newbolt. Pp. viii+312. (London: Longmans, Green, and Co., 1918.) Price 7*s*. 6*d*. net.

SIR HENRY NEWBOLT has succeeded in presenting a very fair view of the work of our submarines and of the measures taken to meet the U-boat menace. Despite the fact that a great deal of further information has been published since the date of the armistice, the book will be found to be useful on account of the connected presentment. Opening with the evolution of the submarine and a description of the submarine of to-day, the author passes to the methods of the submarine in attacking warships, and the means taken by warships in meeting attack and in aggressive action. The work of our submarines in the Baltic and in the Dardanelles occupies a large section of the volume, and the work of our trawlers, destroyers, P-boats, and Q-boats is well described. The book closes with an account of the Zeebrugge and Ostend attacks.

One interesting aspect of the submarine campaign is a knowledge of the feelings of the hunted during the chase. This is dealt with in chap. xvi., by quoting a long extract from the "War Diary of U 202," by Lt.-Commdr. Freiherr Spiegel von und zu Peckelsheim. Sir Henry Newbolt comments on the extract by saying that it is not unnatural that von Peckelsheim should enlarge upon his terror at the moment and his self-congratulation afterwards. But his diary contrasts badly with reports from our own submarine commanders in worse circumstances. "We may take pleasure in noting that the steadiness of nerve and the scientific view are in our favour."

Aids in Practical Geology. By Prof. Grenville A. J. Cole. Seventh edition, revised. Pp. xvi+431. (London: Charles Griffin and Co., Ltd., 1918.) Price 10*s*. 6*d*. net.

THERE are few living authors who take so wide a view of the phenomena and problems of geology as Prof. Cole, and none who is more capable of making the subject of interest to the student. He stands out, too, among his contemporaries in his appreciation of the work of the pioneers of the science, and in particular of the French petrologists of the first half of the nineteenth century, especially of Cordier and Delesse. He gives an interesting record of the latter's procedure in determining the volumetric mineral composition of a rock by the measurement of areas on a polished slab, and explains how it may be applied to sections under the microscope. Prof. Cole does not, however, refer to the linear method in which the same result is obtained by the measurement of the mineral intercepts on lines drawn over the surface. This method, which has largely superseded the area method in microscopic work, was described by Delesse in the same paper, though the credit for it is usually given to Rosiwal, who published an account of it just fifty years later in 1898.

In the limited space at the author's disposal it was impossible to include everything he might have wished, but perhaps in a new edition he will endeavour to find room for the shadow (Schröder van der Kolk) method of determining under the microscope the refractive index of grains or fragments relatively to the medium in which they are immersed. It is at once very simple and easily applied. J. W. EVANS.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Intravenous Injections in Cholera.

IN the address given by Sir Leonard Rogers to the Indian Science Congress at Bombay (NATURE, May 29) reference is made to the treatment of cholera by injections of saline solutions, with the object of replacing the fluid lost from the blood, which loss may amount to 67 per cent. of the plasma volume. The distinguished worker found that isotonic sodium chloride solution (0·85 per cent.) was practically useless, but that hypertonic solutions (1·2 per cent.) were of much greater value. Since the walls of the blood-vessels are freely permeable to salts, there is no permanent difference of osmotic pressure between their contents and the tissue spaces outside them. Hence there is no permanent force to prevent the escape of fluid from the blood-vessels. So long as the salt-content of the blood, as raised by the introduction of hypertonic solutions, exceeded that of the tissue fluids in his cases, there would be absorption of water and the blood-volume would be maintained; but before long the salt concentration of the tissues would rise to that of the blood, and there would no longer be the difference of osmotic pressure necessary to hold the fluid in the circulation against the filtration due to the arterial pressure. This would explain the repeated injections found necessary by Sir Leonard Rogers. In some experiments that I have made, 2 per cent. sodium chloride was found to leave the circulation and cause œdema, although not so rapidly as isotonic solutions did.

Although the walls of the blood-vessels are permeable to salts, they are impermeable to colloids, so that if we could introduce a solution of a colloid which possesses an osmotic pressure, it would not leave the circulation, and its property of attracting water and preventing loss by filtration would be more or less permanent. We have such a colloid in gum-acacia. I have been able to show that a 6 or 7 per cent. solution of this substance in 0·9 per cent. sodium chloride maintains the blood-volume under various conditions in which it was defective. Such solutions were used extensively in France for the treatment of hæmorrhage and wound-shock.

I would therefore venture to recommend the trial of the method in cholera. I understand that some steps have been taken at Aden in this direction. Gum-saline has been used by Dr. Burkitt in Nairobi for black-water fever, and found to raise the blood-pressure permanently and to restore the renal function. Sir Leonard Rogers refers to the last as a very serious factor in cholera, and the state in this disease appears to be such as promises better reaction to intravenous fluids than does black-water fever.

The calcium bicarbonate contained in gum serves also to neutralise any acid produced in the tissues owing to defective blood-supply, and if the physiological action of calcium is required, no further addition is necessary.

Of course, the treatment by gum-saline is not to be regarded as a cure in the ordinary meaning of the word. It keeps up the normal circulation and allows other means, such as are mentioned by Sir Leonard Rogers, to be used effectively. W. M. BAYLISS.

University College, London.

A Crocodile on Rotuma.

CAPT. W. W. WILSON, formerly harbour-master of Levuka, Fiji, has sent me a photograph of a crocodile taken by Mr. G. Missen. This animal landed alive on Rotuma in July, 1913, being afterwards speared by the natives. Rotuma lies 260 miles due north of the Yasawas, the most westerly islands of the Fiji group, and 600 miles east of the New Hebrides and Santa Cruz groups; the nearest Solomon islands are upwards of 300 miles further west.

The photograph represents a full-grown adult crocodile. Dr. H. Gadow has identified it as *Crocodilus porosus*, Schneider, a species which has the habit of wandering out to sea. It is found from the Bay of Bengal to the Solomon Islands. The British Museum Catalogue of Reptiles mentions Fiji as within its area of distribution, but gives no precise record of any occurrence there. It certainly did not come from Fiji or any lands to the east, as crocodiles do not now exist on them, though native legends of live crocodiles landing were rife in Fiji when I was there in 1896–97. It must indeed have crossed from the west, and covered at least 600 miles of open, landless sea. This occurrence is sufficiently remarkable to be placed on permanent record. J. STANLEY GARDINER.

University of Cambridge.

Calendar Reform and the Date of Easter.

As an influential effort is apparently being made in Paris to bring the question of the improvement of the Gregorian calendar before the Peace Conference, I should like to direct the attention of the scientific, commercial, and ecclesiastical authorities who may be interested to the exceptionally favourable opportunity afforded for such rectification by the calendar of the year 1925.

In recent years many proposals for the improvement of the calendar, or rather for the adoption of another, have been placed before the public, but not much consideration has been given to the question of how such an improved calendar is to be coupled to the existing calendar without breach of continuity.

The Gregorian almanac for the year 1925 offers an unusually favourable opportunity for effecting this. If May 31 in that and all following years were declared to be excluded from the weekly series, and if the same rule were applied to the odd day in all leap-years thereafter, it is obvious that the calendar of 1925 with the above modification would become the perpetual calendar of the future.

In this calendar March 1 is a Sunday, and, without in any way changing the enumeration of the years for purposes of dating, that date could very conveniently be recognised as the commencement both of the business and financial, and also of the ecclesiastical, year. Easter Sunday could not be fixed for a more suitable day than April 12, which is the date of its occurrence in the year mentioned, and Pentecost would naturally and appropriately fall on May 31, the day already suggested for exclusion from the weekly series. Pentecost being the anniversary of the foundation of the Christian Church, its special sequestration in this way makes a strong appeal to the ecclesiastical authorities.

Under the above calendar it would be quite unnecessary to remove the 366th day from its position at the end of February, and the only other change required to equip the almanac with equal quarters and half-years would be to restore the original Julian syllabus of months by removing the odd day so unfortunately added to August by Augustus, and restoring it to February. August, 1919, might appropriately be the last to bear the stigma of imperial disfigurement.

I venture to say that an equally favourable opportunity for initiating the reform will not occur until the same almanac is repeated in 1936, when, however, it is complicated by a leap-day. ALEXR. PHILIP.

The Mary Acre, Brechin, N.B., May 8.

Glossina and the Extinction of Tertiary Mammals.

DR. G. D. H. CARPENTER (NATURE, March 20, p. 46) asks why we should suppose that the occurrence of tsetse-flies (Glossina) in the Miocene of Colorado might have had anything to do with the extinction of some of the large Mammalia. He points out that such flies exist in Africa to-day, carrying trypanosomes, and the native Mammalia nevertheless survive and flourish. It is known, however, that in Miocene times there were extensive migrations of animals, from mammals to insects, and the New and Old Worlds each received important contributions from the other. In such periods of migration it is perfectly conceivable that Glossina might appear in a new region, carrying a trypanosome which would be highly pathogenic for certain elements of the resident fauna. Even in Africa we do not know what animals may be absent to-day owing to the former prevalence of disease-producing organisms.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, April 24.

INDICATIONS OF OIL IN DERBYSHIRE.

AFTER a somewhat lengthy interval, the attention of the public has again been directed to the Government drilling operations for oil in this country. On May 26 the *Times* described the progress which had been made in the work, and stated that several of the bores had now reached a critical depth. At any moment oil might be discovered. This was followed three days later by the announcement that oil had been found in the Hardstoft No. 1 boring near Chesterfield. Further details added that the oil had risen 1000 ft. in the well. The form of the announcements was somewhat misleading, and they need to be stripped of their trappings to arrive at a true perspective. A show of oil has been found at Hardstoft—nothing more. Such shows of oil have been found before in the British strata, and have invariably proved to be of little or no value. It remains to be proved that the present indications at Hardstoft are of a different calibre, and it would have been well to postpone, or at least moderate, the announcement of the discovery until the resumed drilling operations had indicated the quantity of oil which was forthcoming.

The position of the general drilling operations in Britain may be summarised as follows. Wells are being drilled in three areas, Chesterfield, North Staffordshire, and Midlothian. The operations in the last two areas are merely in their preliminary stages, but in the Chesterfield region the work is further advanced, and two of the seven wells—namely, Brimington and Hardstoft No. 1—have almost attained their proposed depths. Shows of gas have been encountered in several of the bores, but the porous horizons of the Millstone Grits, where pierced, have in all cases failed to produce the oil which was anticipated. To this extent, then, the results have been disappointing. However, it has never been intended to limit exploitation to the Millstone Grits. The underlying Carboniferous Limestone has been considered by some to be a better horizon for testing, and the wells are being continued through the Yoredale Shales in order to pierce this formation. Both the Hardstoft No. 1 and Brimington bores have almost reached the Carboniferous Limestone, and the oil which is announced in the former probably comes from the beds near the junction.

It must be emphasised that there is nothing in the present situation to warrant the unduly optimistic attitude of a section of the Press. The statement that this is the first discovery of oil in substantial quantity in England is incorrect, and greatly exaggerates the present indications. The announcement that the oil has risen 1000 ft. in the well may bear two interpretations. It may be that the whole liquid column is composed of oil, or it may be merely an upper layer of oil floating on a column of water, as in the case of the Kelham bore. The shales and banded limestones immediately above the main limestone in Derbyshire often contain small quantities of petroleum, though the porosity of these strata is too small to yield large quantities of the material. It is possible that every well which is sunk into these beds will yield some indications of petroleum, but the small porosity and other factors of preservation limit the hope of a commercial production of petroleum.

Judgment must be suspended until the results of the resumed drilling operations are known. In the meantime it is fortunate that the Government has prevented promiscuous drilling, and thus minimised the evils of fevered financial speculation. The Canadian oil boom of 1914, based on an oil show similar in type to the present indications at Hardstoft, and which ended in nothing, is a typical example of these deplorable scrambles.

V. C. ILLING.

THE SOLAR ECLIPSE.

TELEGRAMS received by the Astronomer Royal report that at the station at Sobral, in Brazil, occupied by Dr. Crommelin and Mr. Davidson for photographing the field of stars round the sun on the occasion of the total eclipse of the sun last week (May 29), the sky was clear for at least part of totality, and that the programme was satisfactorily carried out. The photographs have been developed, and all the stars expected are shown on the plates taken with the astrographic lens, as well as on those taken with a second telescope lent by Father Cortie. The expedition will remain at Sobral until the necessary comparison photographs are taken *in situ*. The message from Prof. Eddington at Prince's Island, off the coast of West Africa, which reads "Through cloud, hopeful," may be taken to imply that some success will also be derived from the work of this expedition.

It will be remembered that Prof. Eddington and Mr. Cottingham were provided with the 13-in. object-glass of the astrographic telescope of the Oxford University Observatory, whilst the observers in Brazil had the similar object-glass from Greenwich, and that the programme at both stations was to take photographs of the stars that surrounded the sun, of which there are at least twelve within 100′ of the sun's centre of photographic magnitude ranging from 4·5 to 7·0, for the purpose of testing Einstein's relativity theory of gravitation, and also the hypothesis that gravitation, in the generally accepted sense, acts on light. Photographs that have been taken during the eclipse will be compared with others that have been, or will be, taken of the same stars in the night sky to detect any displacement that may be considered to be due to the presence of the sun in the field.

There is at present no information as to the type of the corona, and apparently few observing parties have been organised to make observations to record this. From a note in the daily Press last week, said to emanate from the Yerkes Observatory, it seems not unlikely that a large prominence may have been on the limb of the sun at the time of the eclipse.

It had been announced that the Cordoba Observatory would dispatch an expedition to Brazil, and that possibly Prof. Abbot, of the Smithsonian Institution, would proceed to La Paz, Bolivia, where the eclipse happened at sunrise, with coronal cameras and with instruments for measuring the sky radiations by day and night, but it is too early to have heard of any results of such observations. Also it has been announced that Prof. D. P. Todd would take photographs of the eclipse from an aeroplane at a height of 10,000 ft. from the neighbourhood of Monte Video, where the eclipse would only be partial.

As to experiments other than astronomical, the actual programme arranged by the British Association Committee for Radio-telegraphic Investigation, the object of which was given in NATURE of May 8, was that the sending-stations at Ascension and the Azores with others in America should send letters of the alphabet at intervals from 11h. 30m. (G.C.T.) until 14h., and that any observers who would take part in the experiment should record these and their strength by a number according to a scale familiar to wireless telegraphists. A scheme for making special magnetic and allied observations during the eclipse was organised by the Department of Terrestrial Magnetism of the Carnegie Institution under the direction of Prof. Bauer, with stations at (1) La Paz, Bolivia, (2) Huancayo (north of belt of totality), (3) near Sobral, Brazil, (4) Prince's Island, and other stations outside the belt of totality if possible. The reports of the observations of this kind that have been made will be given as soon as possible, but much cannot be said until published results arrive from America.

WIRELESS TELEPHONY.

MARCONI'S Wireless Telegraph Co., Ltd., gave a very interesting demonstration of the latest developments of wireless telephony at its works at Chelmsford on May 28. Although there was nothing very new from the scientific point of view, yet the developments in engineering design were remarkable, especially in the receiving apparatus. Many of the devices proved of the utmost value to the Army during the war. We were impressed with the portable wireless telegraph station for use with pack or wheeled transport. Six men are required to work the set, and the whole station can be erected in ten minutes. The masts are of steel, 30 ft. in height, and a single horizontal aerial is used, the earth connection being made with strips of metal gauze placed on the ground. The generating set consists of a two-cylinder, $2\frac{3}{4}$-h.p. petrol engine, which drives a high-frequency $\frac{1}{2}$-kw. alternator. The "instrument load" consists of transmitting-valves, high-frequency transmitting-circuits, microphone, etc., all contained in a teak travelling-case.

To work the apparatus, the petrol engine is started. This drives the high-frequency alternator. The current generated is carried to the transmitting-circuits, where it is transformed by a series of transformers. The final transformation raises the potential to 10,000 volts; the current is then rectified by a Fleming valve and converted into a continuous-wave current by a system of condensers and choke coils. This current energises the aerial circuit, where a large fraction of the power is radiated off into space. For the transmission of speech the amplitude of the oscillations generated in the aerial is varied by a microphone into which the operator speaks. The microphone acts on a transformer connected in the grid circuit of the transmitting-valve.

The receiver consists of a simple tuning arrangement which is connected to the aerial. The oscillatory currents produced by the received signals are amplified by a series of oscillatory valves. The last of the valves rectifies the currents and feeds the telephones through a suitable transformer. Conversation between the two stations is then carried on in exactly the same way as in ordinary telephony.

For normal flat country the guaranteed range for telephone transmission is 60 miles, but communication can sometimes be made over 120 miles. For continuous wave (C.W.) transmission the guaranteed range is 200 miles. A demonstration of the working of the apparatus was given, and conversation was carried on as easily as over an ordinary telephone line.

Amongst other devices shown were the wireless telephone apparatus used in aeroplanes with the pendent aerial and the windmill generator. Very large high-power spark generators for long-distance transmission were shown in action. A demonstration was also given of telephonic com-

munication with distant stations from a motor-bus in motion. The aerial fixed on the bus was only a rectangular coil about 3 ft. square, containing a few turns of wire. The bus drove some miles towards Colchester, and then its position was accurately located by the Marconi direction-finding device, which was so useful in other days for locating the position of enemy aircraft. Now it promises to be very useful in connection with navigation by sea and air. In the English Channel, for instance, a ship furnished with direction-finding gear can check its position at frequent intervals by taking bearings on the numerous shore wireless stations without disturbing them in their work. The relative position of other ships also can be ascertained, and the dangers of navigation in fog greatly lessened.

The Marconi Co. is erecting a huge aerial in Buenos Aires, and it seems probable that in two or three years' time telephonic speech will be possible between this country and the Argentine. Unlike ordinary telephonic waves transmitted over wires which travel with speeds depending on their wave-lengths, aerial waves all seem to travel with the same speed, and so it is highly probable that, even over this distance, there will be no "speech distortion."

THE ATLANTIC FLIGHT.

THE American seaplane N.C.4 has completed its flight to England, *via* the Azores and Portugal, and arrived at Plymouth at 1.26 p.m. G.M.T. last Saturday. The honour of the first Atlantic crossing by air thus falls to the Americans, though the yet greater honour of the first direct flight from continent to continent remains to be won. The feat accomplished by the N.C.4 clearly illustrates the advantage of the seaplane for long flights over the ocean, owing to its ability to alight on the water in any calm locality and carry out minor repairs, if necessary. Even in mid-Atlantic such an aircraft would have a fair chance to rectify some slight defect and proceed on its course, whereas an aeroplane is certain to be useless for further flight if forced to descend on the water.

The three longest stages of the flight of the N.C.4 were as under:—

	Miles
Newfoundland to the Azores ...	1381
Azores to Portugal	904
North of Spain to Plymouth ...	500

The machine also made a flight of 190 miles in the Azores, and proceeded from Lisbon to the North of Spain in two short stages before making the final flight to England. The last 500 miles were accomplished in 5 hours, a fact that speaks well for the condition of the machine after its preceding long journeys. The seaplane was obliged to fly very low on account of fog, and the greater part of the last stage was covered at an altitude of less than 100 ft. The satisfactory termination of this trans-Atlantic flight reflects the greatest credit upon Lt.-Commdr. Read and his crew, who will ever be remembered as the first persons to cross the Atlantic by air.

In view of the length of the first stage of this historic flight, viz. 1381 miles, it seems reasonable to expect that a machine of this type should soon be able to attempt the direct passage—a distance only 420 miles greater than that already accomplished. An aerial voyage from England to Australia also seems well within the reach of such a seaplane, convenient harbours or lakes *en route* being selected as halting-places. A seaplane has the disadvantage, for such a flight, that a forced landing on *terra firma* is as fatal as is a descent at sea to an aeroplane, and it is conceivable that the future will produce a machine capable of alighting either on water or land. Such a machine would have vast possibilities, but the design presents many difficulties.

Meanwhile, another great triumph has been added to the record of flight, and it seems likely that the present year will witness even greater achievements in the aeronautical world.

NOTES.

THE honours announced on the occasion of the King's birthday on June 3 number several thousand, but are confined almost entirely to the fighting forces. A further list will be issued in a few days. We notice in the list published on Tuesday the following distinctions conferred upon men known in the scientific world:—*K.C.S.I.:* Dr. Michael E. Sadler, Vice-Chancellor of the University of Leeds and chairman of the Calcutta University Commission. *C.I.E.:* Lt.-Col. J. Stephenson, principal and professor of biology, Government College, Lahore, and Mr. R. S. Hole, Imperial Forest Botanist, Dehra Dun. *Knights Bachelor:* Mr. Charles Bright and Dr. J. H. MacFarland, Chancellor of the University of Melbourne.

WITH the approval of H.R.H. the Duke of Connaught, president of the Royal Society of Arts, the council has awarded the society's Albert medal for 1919 to Sir Oliver Lodge "in recognition of his work as the pioneer of wireless telegraphy." The medal was instituted in 1864 to reward "distinguished service in promoting arts, manufactures, and commerce." The presentation will be made by the Duke of Connaught at Clarence House on June 6.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 14.

LORD BLEDISLOE has been elected chairman of the governors of the Royal Agricultural College, Cirencester, in succession to Lord Moreton, who has resigned.

DR. JOSEPH BURRELL, who, after serving for five years as assistant professor of geology at Yale University, was appointed to a full professorship in 1908, died recently in his fiftieth year.

MR. HAROLD KING, of the Wellcome Chemical Research Laboratories, has been appointed by the Medical Research Committee to the post of organic chemist in the department of biochemistry and pharmacology.

A CONFERENCE on "The Benefit to the Workman of Scientific Management" will be held under the

auspices of the Industrial Reconstruction Council on June 10, at 5.30 p.m., in the hall of the Institute of Journalists, 2 and 4 Tudor Street, E.C.4. The chair will be taken by Dr. H. Chellew, and Major Pells, R.E., will introduce the subject, after which the discussion will be open. No tickets are necessary.

THE seventy-first general meeting of the Institution of Mining Engineers will be held in the rooms of the Geological Society, Burlington House, on Thursday, June 19, under the presidency of Mr. G. B. Walker. Two institution medals will be presented for the year 1918–19 to Dr. Auguste Rateau (French) and M. Victor Watteyne (Belgian) respectively.

A BIOLOGIST having a knowledge of life in streams is about to be appointed by the Joint Committee of the Board of Agriculture and Fisheries and the Road Board to assist in experiments in connection with the tarring of roads. Applications for the post, marked "Biologist," must reach the Secretary of the Road Board, 35 Cromwell Road, S.W.7, by, at latest, the first post of Monday, June 16.

APPLICATIONS are invited by the Imperial Mineral Resources Bureau (14 Great Smith Street, S.W.1) for the position of Chief of the Intelligence and Publications Section of the Bureau to compile and produce for publication statistical information in regard to the resources, production, and cost of production of metals and minerals from all parts of the world. The forms of application, with testimonials, are returnable by, at latest, June 19.

THE death is announced, in his eightieth year, of Dr. Alexis A. Julien, of South Harwich, Mass. From 1860 to 1864 Dr. Julien was the resident chemist on the guano island of Sombrero, and made scientific collections there for the Smithsonian Institution. From 1865 to 1909 he was on the staff of the School of Mines, Columbia University. He had also been connected with the Geological Surveys of the States of Michigan and North Carolina.

THE annual meeting of the British Science Guild will be held on June 17, at 4 p.m., at the Goldsmiths' Hall, by kind permission of the Master and Court. The speakers will be the Right Hon. Lord Sydenham (president of the guild), Major-Gen. the Right Hon. J. E. B. Seely, Under-Secretary of State, Ministry of Air, Sir Joseph Thomson, president of the Royal Society, and Sir Robert Hadfield, Bart. Cards of invitation to the meeting may be had on application to the Secretary, British Science Guild, 199 Piccadilly, W.1.

A PORTION of the Ministry of Munitions has become a branch of the Board of Trade. The portion that is transferred to the Board of Trade will deal with questions of assistance to, and organisation of, the optical scientific instrument, glass, and potash industries, including administration of the Glass Control (Consolidated), Clinical Thermometer, and Potassium Compound Orders. All communications relating to such questions in future, therefore, should be addressed to the Assistant Secretary, Board of Trade, Industries and Manufactures Department, Scientific Instruments, Glassware, and Potash Production Branch, 117 Piccadilly, W.1.

AT the annual general meeting of the Linnean Society, held on May 24, the following were elected officers and council for the ensuing year:—*President:* Dr. A. Smith Woodward. *Treasurer:* H. W. Monckton. *Secretaries:* Dr. B. Daydon Jackson, E. S. Goodrich, and Dr. A. B. Rendle. *Council:* E. G. Baker, Dr. W. Bateson, *Prof. Margaret Benson, *E. T. Browne, R. H. Burne, S. Edwards, Prof. J. B. Farmer, E. S. Goodrich, Dr. B. Daydon Jackson, C. C. Lacaita, *G. W. E. Loder, H. W. Monckton, R. I. Pocock, Dr. A. B. Rendle, Dr. D. H. Scott, Miss A. Lorrain Smith, A. W. Sutton, *Dr. Harold Wager, Lt.-Col. J. H. Tull Walsh, and *Dr. A. Smith Woodward (new members are shown by an asterisk). Prof. I. Bayley Balfour was presented with the Linnean medal in gold.

A CONFERENCE devoted to the consideration of problems of reconstruction in relation to public health has been arranged by the Royal Institute of Public Health, to be held from Wednesday, June 25, to Saturday, June 28, inclusive. The inaugural meeting of the conference will be held in the Egyptian Hall of the Mansion House, under the presidency of the Right Hon. the Lord Mayor of London, and the other meetings will be held in the Council Chamber of the Guildhall of London. The subjects to be considered will come under the following heads:—(1) The Work of the Ministry of Health; (2) The Prevention and Arrest of Venereal Disease; (3) Housing in Relation to National Health; (4) Maternity and Child Welfare; and (5) The Tuberculosis Problem under After-War Conditions.

IN view of the imminent resumption of international co-operation in the study of questions connected with the art of illumination and the sciences related thereto, a meeting of the National Illumination Committee of Great Britain was held on May 27, when vacancies in the executive of the committee, due to the decease of Mr. W. Duddell and Prof. Silvanus P. Thompson, were filled. The executive, with the institutions represented, is now as follows:—Chairman, Mr. A. P. Trotter (Illuminating Engineering Society); vice-chairmen, Mr. John Bond (Institution of Gas Engineers) and Mr. Kenelm Edgcumbe (Institution of Electrical Engineers); hon. secretary, Mr. Haydn T. Harrison (Institution of Electrical Engineers); hon. treasurer, Mr. W. J. A. Butterfield (Institution of Gas Engineers); and representatives on the executive committee of the International Commission on Illumination, Dr. Harold G. Colman (Institution of Gas Engineers) and Mr. Leon Gaster (Illuminating Engineering Society). The resumption of research work, etc., was considered, and a programme for further discussion at a meeting at an early date was settled.

THE Air Ministry has begun the publication, in the *Geographical Journal* for May (vol. liii., No. 5), of some notes on proposed air routes. The first one is the route from Egypt to South Africa. From Cairo to Kosti there seems to be little difficulty: either the Nile or the railway indicates the course. South of Kosti is a forest region, and the Nile banks are wooded or swampy, while the sudd region makes the White Nile a practically impossible route. The route proposed is by Sennar up the Blue Nile to Roseires, thence south to Gambela and the western shore of Lake Rudolf; or from Roseires by Nasser on the Sobat to Gondokoro. But on either route landing-places are not numerous and communications are bad. It is suggested that a seaplane might be the best type of machine for this section. A seaplane is also favoured for the route from Gondokoro to Lake Victoria by Murchison Falls. Across Lake Victoria the proposed route is to Mwanza by seaplane, thence to Kigoma and Abercorn on Lake Tanganyika. The route continues by Broken Hill to Bulawayo, thence following the railway to Mafeking, Kimberley, and Cape Town. Alternative routes are suggested for parts of the course. It is proposed to provide landing-places, so far as possible, every 200

miles. The Air Ministry states that it will be glad to receive criticisms and remarks.

DR. CHARLES GORING, late Medical Officer to Manchester Prison, whose recent death after a short illness deprived the Prison Medical Service of one of its ablest members, had a brilliant career as a student at University College, London, and from his early years showed a strong bent towards scientific research. This tendency led him to the study of medicine, and his special interest in psychology and general anthropology found an ample field of work when he was appointed to the staff of Broadmoor Criminal Lunatic Asylum, and later to the Prison Medical Service. During several years Dr. Goring contributed a vast number of observations to an inquiry which had been undertaken at several prisons concerning certain doctrines as to the relation of crime to physical and mental peculiarities, and he readily undertook the great labour entrusted to him of tabulating the whole of the observations made and of writing the report. This report was published by the Government under the title "The English Convict: A Statistical Study," and has attracted wide attention, both here and in other countries, among those interested in the study of crime and criminals. It is impossible in this necessarily short notice to enter into further criticism of the method of research followed by Dr. Goring and of the conclusions arrived at by him than that made in NATURE for March 26, 1914 (vol. xciii., p. 86), soon after the publication of this work. It must suffice to say that the nature and arrangement of the material and the inferences drawn therefrom follow closely on the lines of the biometrical school, and that the validity of the conclusions depends on the full acceptance of the applicability of the method to the material. Dr. Mercier's recent book on "Crime and Criminals" shows that much can be said on this subject from a point of view which differs widely in many respects from that set forth in "The Statistical Study of the English Convict"; but, looked at from any point of view, this work will remain as a monument to Dr. Goring's untiring industry, his single-minded enthusiasm for scientific research, and his unquestionably great ability.

UNDER the title of "The Dendroglyphs, or Carved Trees of New South Wales," Mr. R. Etheridge has published a memoir, issued by the Department of Mines (Memoirs of the Geological Survey of New South Wales, Ethnological Series, No. 3). The records of these trees begin with a note by Surveyor-General J. Oxley in 1817, and since that time many specimens have been discovered. They seem to fall into two groups—those which adjoin native graves, and may be considered memorials of the dead or of some important tribal event; and those carved with symbols, apparently in connection with the Bora, "man-making" or puberty rites. They do not appear to be associated with tree-worship or with any regular cult of the dead. Some of the designs may be of a totemic nature, and they have been compared with those engraved on the inside of skin-cloaks worn by the aborigines. As to the date of these memorials, all that seems clear is that the glyphs were made after the natives became possessed of metal tools. Very little is known of the class of records associated with the Bora rites, but some of the designs seem to be totemistic. An attempt is made, without much success, to compare the designs used by Dravidian tribes in southern India, with whom the Australians are supposed to be racially connected. The memoir is interesting and well illustrated, and raises many questions in connection with the beliefs and ceremonies of the natives of Australia.

DR. A. GALLARDO continues his extensive memoir on the ants of the Argentine with a monograph on the Ponerinæ (Ann. Mus. Nac. Hist. Nat. Buenos Aires, vol. xxx., 1918). To the thirty species comprised in this section he devotes more than a hundred pages of careful description with clear structural figures.

THE greater portion of part 5, vol. xv., of the Records of the Indian Museum is occupied by the second instalment of Mr. E. Brunetti's "Revision of the Oriental Tipulidæ." Nearly six hundred species of these insects (the crane-flies or "daddy-long-legs") are now known from India and south-eastern Asia, so that the field of study is extensive. Mr. Brunetti's treatment is somewhat rigidly systematic.

MR. J. M. SWAINE issues, as Bulletin 14 of the Entomological Branch of the Canadian Department of Agriculture, what may be regarded as a monograph of the Canadian bark-beetles (Scolytidæ), dealing with structure, classification, habits, and methods of control. A feature of this memoir is the beauty of the illustrations, though some of the plates are overcrowded with figures.

WE have received the first part (January, 1919) of a "Treubia," a new publication issued from the famous Botanical Garden of Buitenzorg, Java. It contains five entomological papers by Dr. W. Roepke, of which one on two new Javan species of Oligotoma is of bionomic as well as of systematic importance, the curious Embiidæ—allies of the Termites—to which these insects belong, being of exceptional interest. In his other papers, on various beetles and wasps, the author gives much welcome anatomical detail.

SOME interesting contributions to agricultural zoology have lately been made by workers in India. The report of the Imperial Entomologist (Mr. T. B. Fletcher) for 1917–18 contains descriptions, with excellent figures, of the larval stages of several beetles and moths of economic importance. Dr. E. J. Butler writes (Mem. Dept. Agric. India, Bot. Series, vol. x., No. 1, 1919) on the rice worm (*Tylenchus angustus*), and points out that this destructive eelworm can migrate over apparently dry surfaces if the atmosphere be saturated so as to cause the formation of a droplet or film of moisture around the worm's body. This fact accounts for the general immunity of the "boro" or spring rice crop to the disease caused by the worm, as the air is at its driest from February to May. A valuable paper on the Aphididæ of Lahore by the late Mr. Bachambar Das appears as No. 4 of vol. vi. of the Memoirs of the Indian Museum. Forty species are described, with critical systematic and bionomic notes, illustrated with sixteen plates. The work shows high entomological ability, and the early death of the author, resulting from his devotion to students attacked by cholera, has cut short a career of great promise.

RECENT geological work in France and her colonies is usefully reviewed by M. J. Révil in the *Revue générale des Sciences* (January 15 and 30, 1919).

IN *Naturen* for November, 1918, Hr. N. H. Kolderup records the excursions of the first Scandinavian Geological Congress in Denmark, and furnishes a good map, after V. Nordmann, of the concealed geology of the north of Jylland (Jutland). The strata range from Senonian to Miocene.

THE great size of the boulders in the rubble-drift of Brighton leads Mr. E. A. Martin to conclude (*Hastings and E. Sussex Naturalist*, vol. iii., p. 64) that some form of moving ice occupied the local

valleys at the time of deposition of this drift. The paper provides further evidence of the influence of the Glacial epoch on the older superficial deposits of southern England.

MR. A. L. HALL furnishes a complete review of the minerals used as asbestos and of the requirements of the trade in a memoir on "Asbestos in the Union of South Africa" (Mem. 12, Geol. Surv. S. Africa, 1918, price 5s.). Crocidolite naturally receives full treatment, and the author's new species amosite, with a long, flexible, and strong fibre, is recommended as being less fusible than crocidolite, which contains more soda. Amosite, indeed, seems to rival chrysotile in its commercial qualities.

PROF. W. M. DAVIS contributes a further comprehensive paper on "The Geological Aspects of the Coral-reef Problem" to *Science Progress* (vol. li., p. 420, 1919). Mr. W. G. Foye, in a memoir on "Geological Observations in Fiji" (Proc. Amer. Acad. Arts and Sciences, vol. liv., No. 1, 1918), states that he finds no evidence of the wave-cut Pleistocene platform which is postulated by Prof. R. D. Daly in his theory of the post-Glacial origin of the reefs, and he remarks that "if the Glacial-control theory is still adhered to, the atolls must be pre-Pleistocene in age." The Fiji area shows that elevation has here taken place in differing degrees, leading to various states of erosion. At present "all of the islands are being rapidly reduced to sea-level by atmospheric solution." Subsidence has already followed on the last uplift, and some of the most eroded islands have, in consequence, deep lagoons.

A "TSUNAMI" is the name given in Japan to any abnormally high water that causes damage to property. Most "tsunamis" are due to submarine earthquakes or volcanic eruptions. The sea-level then suddenly rises or falls, after which a train of waves succeeds, which may last a few hours or days. Other "tsunamis" are caused by heavy winds along the coast or by typhoons. These different forms of "tsunamis" are considered by Mr. S. T. Nakamura in a paper read before the Tokyo Mathematico-Physical Society (Proceedings, vol. ix., 1918, pp. 548–55), in which special reference is made to the "tsunami" caused by an earthquake off the eastern coast of North Japan on September 8, 1918. Mr. Nakamura explains the wide variation in the height of the waves by supposing that movements in adjacent quadrants are opposite in direction, so that the height of the waves would be zero or very small on the boundaries of the quadrants, and greatest along their central lines. The evidence of the recent "tsunami," so far as it goes, favours this explanation.

THE Danish Meteorological Institute has published its report for 1918 on the state of the ice in the Arctic Seas. The year was a very favourable one for navigation to Spitsbergen. From April until October the west coast was practically free from ice, except for a little around the South Cape in May and June, and a good deal of pack in Bell Sound and Horn Sound in September. The east coast, so far as reports go, seems to have been fairly open late in the summer, and the north coast from June onwards was navigable. In the Greenland Sea, on the other hand, the ice reached far eastward, and seems to have been unusually heavy. Conditions in the Barents Sea and around Iceland seem to have been fairly normal. There was little information from the Kara Sea, except the report of Capt. Amundsen, who found it filled with ice in the middle of August. The entrance to the White Sea was not navigable before May, but the sea remained open until late in the autumn. The report, which is printed, as usual, in Danish and English, is well illustrated with maps.

BULLETIN No. 105 of the University of Illinois contains an account of hydraulic experiments with valves, orifices, hose, nozzles, and orifice buckets. Ordinary gate, globe, and angle valves were purchased in the open market and tested as received; the valves were 1 in. and 2 in. in diameter, and were tested with settings ranging from one-fourth open to full open. It was found that the loss of head caused by small valves varies as the square of the velocity in the pipe for all the valve openings. When wide open, a globe valve causes more than twice as much loss of head as an angle valve of the same size; while a gate valve causes much less loss of head than either a globe or an angle valve, the velocity in the pipe being the same in the three cases. With equal velocities in the pipe, the loss of head for an angle valve is somewhat less when about three-fourths open than when wide open The form or shape of the passageways through a globe or angle valve has a large influence on the loss of head for the small valve openings; the portion of the passageways in which the form seems of greatest importance is in the exit from the valve rather than in the passageways leading to the valve disc. Graphs of the results and tables of the coefficients obtained are included in the paper.

IN an address given to the chemical section of the American Association for the Advancement of Science in December last, Prof. W. A. Noyes emphasises the fact that the theory of valency is one of the most important theories in chemistry. Scarcely any other except the atomic theory, with which it is inseparably connected, has been so fruitful in results which have led to practical applications, and also to the development of chemical knowledge. But in spite of these results, which no one can dispute, the theory just now is more or less in disrepute, especially among physical chemists and teachers of inorganic chemistry. In many elementary text-books structural formulæ are used so sparingly that they make no impression on the student, and in some they are not even mentioned. This attitude is due, in part, to a reaction from the over-emphasis given to the subject at a time when nearly all chemists were working on the structure of organic compounds. In part also it is due to confused ideas on the philosophy of science; to some persons science is only an orderly description of phenomena which we can see and handle, weigh and measure, and connect by mathematical processes. But the positive achievements of the valency theory are so great that no one can doubt that there is in the relations of atoms some reality which corresponds with the theory. At the same time our knowledge is vague and indefinite at many points, so that we cannot yet consider the theory satisfactory. The most important recent advance has been the interpretation of valency in connection with the electron theory, and the beginning which has been made towards the study of positive and negative atoms in organic compounds. As a basis for the better understanding of valency there is need for a more definite knowledge of the structure of atoms. Whatever other conclusions may be reached, it seems certain that this structure will be found to be dynamic rather than static; it is hard to conceive of a quiescent electron.

As is well known, the industry of ferro-cerium flints was practically in the hands of Germany when war broke out. Since then one French manufacturer has succeeded in establishing the industry in France on a scale sufficient to supply the requirements of that

country. In the January–February issue of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* some interesting details are given on the manufacture of these stones or "flints," which are now so well known to smokers in this country. Ferro-cerium is an alloy consisting, for the purpose under discussion, of 30 parts of iron to 70 parts of cerium. The raw material is derived from the monazite sands of Brazil. These sands are enriched until the pure monazite is obtained. They are then treated chemically to extract the oxylate of thorium, phosphoric acid, and oxylates of cerium, lanthane, and didymium. The cerium oxylates are afterwards converted into hydrates or carbonates, then into chlorides. The chloride is finally electrolysed and decomposed into its elements, chlorine and cerium, the electrolytic process being continuous. The pure cerium is alloyed to iron in the proportions mentioned above. The two substances are placed in fire-clay crucibles, which are heated to 1100° C. by a gas furnace. When the alloy is thoroughly liquid it is cast in moulds formed by a series of several hundred sheet-iron tubes, 2·8 mm. in diameter and 30 cm. long. These tubes are allowed to cool in the air and then "stripped," *i.e.* they have an opening down the side and the thin sheet-iron is simply wound off the ferro-cerium, which is left in the form of a thin rod. One kilogram of ferro-cerium contains 5500 "flints" of 5 mm. length, which are each capable of giving some nine hundred flashes. The French manufacturer who took up this industry has also prepared other products of some importance, *e.g.* thorium nitrate, which is being used in a special type of incandescent lamps, and cerium, which is being used for the manufacture of cerium steels. This new application on the part of the French will release them from the German tribute after the war.

M. LÉON APPERT, in the January–February issue of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, contributes a long and interesting paper on the welding of glasses. He traces the history of these attempts from the earliest ages, and considers the technical methods most likely to lead to success. His conclusions are:—(1) That it is always possible to weld together, completely and permanently, glasses of different composition, whatever the constituents of the glasses. (2) That the limits within which the relative proportions of these constituents may be varied are very close; and, to ensure success, the modifications which may result must be carefully borne in mind in practice, such as changes in the quality of the products used, modifications in composition which may occur spontaneously, the temperature at which fusion is carried out, and the duration for which this temperature is applied. (3) As regards conditions of athermancy and diathermancy, the most simple methods should be used for controlling these conditions, a glass of known composition being used as a standard and for purposes of comparison. (4) As regards neutrality, direct experiments with the blowpipe should be made. This kind of test, which is very simple to carry out, gives at the same time information on the greater or less fusibility of the glass, and on the consequences arising out of the use of a variable temperature, which may sometimes be too high or applied too long. (5) As regards the welding of enamels with metals, the question of adhesion being of the first importance, care should be taken over the qualities of the mordant, which must have the same dilatation coefficient at the outset, and at the same time be capable of attacking the underlying metal with the view of multiplying the points of adhesion. (6) The enamel should be employed only in as thin layers as possible and by successive applications. If these conditions are observed, the success of the operation of welding may be regarded as ensured.

IN the *Journal of Agricultural Research* for December 2 last, Messrs. True and Geise give an account of a series of pot experiments carried out to determine the value of greensand (glauconite) deposits as a source of the potassium required by growing plants. Potassium is a normal constituent of glauconite; the question was whether in this silicate it is present in a sufficiently soluble form to be utilisable by the plant. In the result it was found that greensands and greensand marls from Virginia and New Jersey were able to supply sufficient potassium to meet the demands of wheat and red clover during the first two months of growth, *i.e.* at the time when the absorption of potassium is greatest. The plants, in fact, made a greater weight of "tops" than was found in similar cultures where the potassium requirements were supplied by means of the chloride, sulphate, and phosphate. The authors conclude that the deposits mentioned can apparently furnish available potassium to meet the needs of many farm crops, and perhaps of most.

A NEW form of ship's rudder, invented by Mr. J. G. A. Kitchen, of Lancaster, forms the subject of an article in *Engineering* for May 16. The invention permits the boat to be steered, reversed, controlled in speed, and manœuvred in any way from a single tiller, with the engines running continuously at full speed in the forward direction. Complete and direct control is obtained by the steersman over all movements during manœuvring, and all engine-reversing gear may be eliminated. Two curved deflectors forming parts of a circular cylinder partly enclose the propeller. The deflectors are pivoted at the top and bottom on common centres, and are capable of being swung together in the same direction, or equally in opposite directions. A graduated opening or no opening is thus provided for the stream of water leaving the propeller; in the case of no opening, the entire stream of water is deflected forwards, and the boat moves astern. There is a neutral position of the deflectors in which the boat remains at rest with engines working at full speed. The operating gear is exceedingly simple, so that even a novice acquires complete command over the boat's movements after a few minutes' practice. Many of the Admiralty pinnaces, etc., driven by oil-engines have been fitted during the war, although publication of particulars has been hitherto prevented. The following gives some idea of the importance of the device, and relates to trials of a 25 ft. launch belonging to the Air Ministry. Ahead speed, 9·80 knots; astern speed, 3·5 knots (sufficient for all requirements). Full speed ahead to dead stop: boat pulled up in 16 ft. (one man aboard). Time of turning through a complete circle, without progression in any direction: to starboard, 33 secs.; to port, 26 secs. The results for several other boats are given, and are equally good.

THE statement in a letter in last week's NATURE that Messrs. Newton and Wright, Ltd., produced interrupterless machines before "any American firm" had done so should have read "any other American firm." The word "other" was inadvertently omitted from the sentence. Mr. Snook's own factory was the first to place a practical machine on the market, and Messrs. Newton and Wright, Ltd., were the first on this side of the Atlantic.

OUR ASTRONOMICAL COLUMN.

AN EARTH-EFFECT ON THE SUN.—A shift of the lines in the solar spectrum towards the red with reference to the arc-lines which varies with distance from the centre of the disc observed at the solar observatory at Kodaikánal has been attributed to an earth-effect, and an attempt is being made to unravel the problem by observing the spectrum of Venus at different phases. The method of the scheme is to find if a similar shift is apparent in the spectrum of Venus when illuminated by the light of the solar hemisphere which is turned 90° or more from the earth, in which case the phenomenon of the shift of the lines, not being peculiar to the part of the sun towards us, could not be ascribed to a terrestrial cause.

Dr. Gilbert Walker has suggested that the law of increase of shift of the solar lines from the centre of the disc to the limb as observed at Kodaikánal might be explained on the hypothesis of a constant "relativity" shift towards red, combined with a shift towards violet, due to a radial outflow of the gases of the reversing layer.

In his report of the observatory for the year 1918 Mr. Evershed gives the recent progress of the investigation by saying that the Venus plates taken about the western elongation of the planet when the angle Venus—sun—earth was about 45° yield slightly smaller values of the shifts, and there is a progressive diminution of wave-length as the angle at the sun increases. When this angle exceeds 90° the displacements sun—arc all have the *minus* sign—that is, the solar lines reflected by Venus are shifted to violet instead of to red with reference to the iron arc. Mr. Evershed adds that the result of the Venus work seems to dispose finally of the possibility that the solar line-shifts are due to the gravitational effect resulting from Einstein's generalised relativity hypothesis, and thinks the facts undoubtedly show earth-effect, whether the shift is interpreted as motion or otherwise. But he thinks it is very desirable that confirmation of these results should be obtained independently by other observers.

THE LUNAR ATMOSPHERIC TIDE.—The object of a paper read by Dr. S. Chapman before the Royal Meteorological Society in February last, and published in the April issue of the Quarterly Journal of that Society, was to discuss certain recent determinations of the lunar diurnal variation of barometric pressure for Batavia and Hong Kong. Opportunity was taken to refer to previous work and to review the present state of knowledge of the subject. The lunar daily barometric variation at Batavia has a semi-amplitude of 0·065 mm. of mercury, which may be compared with the semi-amplitude of 0·0090 mm. found by Dr. Chapman last year from sixty-four years' observations at Greenwich. This lunar variation is purely semi-diurnal, no appreciable diurnal component being observable. It is independent of lunar phase, and the data are inconclusive as regards the influence of lunar distance; for, though the amplitude is probably larger at perigee than at apogee, the exact ratio is not yet determined. The slight variation of amplitude depending on the moon's declination which tidal theory predicts is not detectable, but a marked seasonal variation affecting both amplitude and phase is rather surprising. The discussion of these results for various stations shows that the amplitude diminishes from the equator approximately as the fourth power of the cosine of the latitude. These departures from theory in the value of this quantity, which, it will be realised, is very small and difficult of detection, lead to the conclusion that the lunar atmospheric tide is not a simple tidal phenomenon, but is complicated by other causes.

THE DATE-PALM SUGAR INDUSTRY OF INDIA.

OUT of India's annual output of some 3,000,000 tons of crude sugar it is estimated that about 10 per cent. is derived from palms and about 4 per cent. from the date-palm, cultivated for this purpose in Bengal. Palm-sugar is obtained by making an incision in the soft upper part of the stem, whereby certain pathological changes appear to be induced, which result in an outflow of liquid containing sucrose. This liquid is collected and concentrated in earthenware pots until it is of such a consistence as to solidify on cooling, when it constitutes "gur" or "jaggery," a crude, dark brown sugar for which there is a considerable demand in India. "Gur" is sometimes treated in native-owned refineries for the production of a more or less white sugar by placing it in baskets with pots underneath, into which the molasses drains, the removal of the molasses being facilitated by placing on the surface of the "gur" a layer, 4 in. or 5 in. deep, of water-weed (*Vallisneria spiralis*) to supply moisture.

This process of producing palm-sugar has been investigated recently by Mr. H. E. Annett, agricultural chemist to the Government of Bengal,[1] chiefly with the object of placing the industry in a better position to compete with sugar and molasses imported from Java.

In the second memoir Mr. Annett gives the results of the investigations he has made with the view of finding means of avoiding loss of sucrose, improving the quality of the crude sugar, modernising the refining process, and economising in fuel. There may be a considerable loss of sucrose by inversion while the juice remains in the collecting pots. This is reduced to some extent by the native process of smoking the insides of the collecting pots before use, but it can be further reduced by coating the insides of the pots with lime-wash. By this use of lime the yield of "gur" can probably be increased by about 20 per cent.

The liquid as it exudes from the trees is normally water-white, but rapidly darkens on boiling, due mainly to the action of alkaline constituents of the juice on the reducing sugars. This darkening can be avoided by neutralising the juice with an acid before boiling down. Suitable acid liquids are lime-juice, alum solution, or aqueous extract of tamarind fruits.

A considerable item in the cost of producing palm-sugar is fuel, which in some of the areas is scarce and dear. Trials of an imported American maple-sugar plant as a means of economising fuel gave disappointing results, but it has been found possible to make various suggestions regarding concentration pans, the construction of the native furnace, and possible waste combustible materials, the adoption of which would lead to a reduction in the fuel costs.

"Gur" made from juice collected in limed pots, and carefully concentrated after neutralisation with acid, was of good colour, and gave the satisfactory yield of 59 per cent. of refined sugar on treatment in a centrifugal machine, whereas from "gur" made by the native process only 31 per cent. could be obtained. A thorough trial of centrifugal machines for refining the crude sugar in place of the tedious native process is recommended.

In his first memoir Mr. Annett made the useful suggestion that it might be feasible to set up small central factories for the production of refined palm-sugar in suitable areas, supplies of juice being bought

[1] Memoirs of the Department of Agriculture in India. Chemical Series vol. ii., No 6, and vol. v., No. 3. (Calcutta: Thacker, Spink, and Co.

from the owners of palm-gardens; but in his second memoir he has regretfully to confess that "such a scheme would be unworkable in practice unless the owner of the plant also had his own trees. Personal experience showed us that one is entirely at the mercy of the cultivator, and no amount of argument will persuade him to sell his juice at a reasonable rate."

SUSSEX NATURAL HISTORY.[1]

THE Hastings and St. Leonards Natural History Society may be congratulated on the well-sustained number of its members (373), on the smallness of its annual subscription (3*s.* 6*d.*), and on the interesting character of its journal. It is, in the opinion of many naturalists, disastrous when local societies undertake to publish scientific information important for its novelty. In after-years the duty of reference to such a source may cause students serious inconvenience. The faunistic lists in the present journal so industriously compiled—of Coleoptera by Mr. W. H. Bennett, of Aphididæ by Mr. F. V. Theobald, of Oligochæta by the Rev. H. Friend, and of the local fauna and flora in general by the late memorable Rev. E. N. Bloomfield, Mr. E. A. Butler, Mr. W. Ruskin Butterfield, Mr. Thomas Parkin, and others—will serve to illustrate this point of view. They are, for the most part, of purely local interest, legitimately recorded in the archives now under review. But in a few instances the entries seem less appropriately placed. Thus Mr. Theobald (vol. ii., No. 1, p. 15) renames two species of Aphis. Mr. Friend (vol. ii., No. 3, p. 119) gives details of an Oligochæte as a new species, though he mysteriously says that he had "described" it more than a year earlier. Among Hymenoptera Mr. Bloomfield (vol. ii., No. 3, pl. 9, p. 101) gives excellent figures of *Neurotes iridescens*, male and female, assigning them on the following page to "*Neurotis iridescens* (Enoch)," name of genus and author's name misprinted. Nearly a year later (vol. ii., No. 4, p. 178) that author, the late Mr. Fred Enock, fully describes the genus and the species, both still considered as new, of this interesting addition to the family of Mymaridæ or fairy flies.

Apart, however, from the impolicy of publishing novelties of classification in local records, Mr. Enock's account of the family is well worth reading, as is Mr. Friend's notice of the Oligochæta. In view of the common demand for significant names in biology, he amusingly notes that in these Annelids, named for few setæ, "sometimes the total number of setæ is two thousand, though the worm may not exceed half an inch in length."

In other branches of knowledge things are not always what they are called. In a lecture to which Mr. Anthony Belt, the editor, directs attention, Mr. J. E. Price, a soldier, explains that "smokeless powder" is not a powder at all. This author, speaking in 1912, suggests that the scientific perfection of arms, by rendering the prospect of war too awful to contemplate, "may materially contribute to the preservation of that peace of nations which is so much desired by every thoughtful man to-day." Meanwhile, some of these "thoughtful men" were engineering a conflict which is reckoned to have cost more than four millions of lives of men, not to speak of heart-aching to millions of women that no one can number.

As might be expected with Mr. Thomas Parkin, sometimes as president and always as enthusiastic supporter of the society, the journal may be said to be on the wing with bird-life, and his well-illustrated articles on historic houses—the Grey Friars, Winchelsea, and its rookery (vol. ii., No. 2), Ashburnham Place (vol. ii., No. 4), and Brickwall and Brede Place (vol. ii., No. 6)—must be of continuing interest. In the last he shows how legends may arise. On a vast oak beam there was a great iron hook, of which he said to a companion, "Look where the old lord used to hang his vassals." Lo and behold, "two or three years afterwards I went there again, and the custodian, having forgotten me, repeated my own words as authentic history." Naturally, in speaking of heronries, Mr. Parkin is all in favour of the noble birds, but those who wish to keep goldfish in ornamental waters have been heard to denounce herons as abandoned pirates. There are two sides to many problems, as Mr. Ticehurst shows in regard to the introduction of the little owl (vol. ii., No. 2).

Remarkably full of interest are the papers on *Eoanthropus dawsoni* by the late much lamented Charles Dawson (vol. ii., Nos. 2 and 4). But here again we must take into account what Mr. Anthony Belt has to say in his article on prehistoric Hastings (vol. iii., No. 1, p. 6). Limits of space exclude from notice many other notable essays, such, for example, as that by Prof. Seward on Wealden floras.

[1] *Hastings and East Sussex Naturalist*, vol. ii., Nos. 1–6; vol. iii., No. 1 (December 31, 1912–18).

NEW IDEALS OF SCIENCE TEACHERS.

A LITTLE more than a year has now elapsed since the publication of the report of the Government Committee which, with Sir J. J. Thomson as chairman, inquired into the position occupied by natural science in the educational system of Great Britain. In the meantime, the recommendations made in this report have been carefully considered by science teachers and others, and at a conference held on May 30, under the auspices of the London County Council, with Sir Cyril Cobb as chairman, the general aims of science teaching were freely discussed.

The main fact which seemed to be made clear by the discussion was that the science teacher of the present day must have two well-defined aims: the one to prepare children for the business of life, and the other to prepare them equally well for the more difficult business of living. On ethical grounds alone there can be no doubt as to which of these is the higher, for "the life is more than meat and the body than raiment." To this we can add that without the meat and raiment and the things of which these are but symbols, life in its broadest, as well as in its more restricted, sense is impossible. Hence these two aims, which appear to some incompatible, or even antagonistic, are in reality convergent, and meet on the common ground of national welfare.

Sir J. J. Thomson, in the opening speech, gave the key-note of the seemingly more ideal theme. Science teaching which is to add to the interests of life and contribute to the *joie de vivre* by dispelling the boredom of unoccupied leisure must be of the popular kind—that is, stimulating rather than feeding. It must cover a very wide field, and be given in the form of lectures, accompanied, when possible, by practical work of a suitable kind.

Such a course as this, essentially the same for boys and girls up to the age of sixteen, must include biology as well as chemistry, physics, and astronomy, for no general course can be considered complete which does not include the consideration of man in relation to his environment. Moreover, if we are to change a C3 population to an A1 nation, we must seek the "elixir

of life" in a new way, and to that end everyone should know something of what Sir Ronald Ross calls the "romance of disease" in order that he may value personal fitness and develop what another speaker called a "health conscience."

To turn now to the other aspect of science teaching, namely, preparation for the business of life, the attention of the meeting was rightly directed by Sir Richard Gregory to the scarcity of university-trained scientific workers required for industrial and other purposes. In the proportion of university students to population England stands far behind other nations, having only 5 per 10,000 as against 10 per 10,000 in America and 17 in Scotland. Though the power to remedy this rests mainly with the Government and those who administer the affairs of education, yet the teacher can do a great deal by endeavouring to turn the talent of the nation into the most suitable channels. We can no longer afford to have square pegs trying to fill round holes, and to prevent this the teacher must consider his work unfinished until every effort has been made to place boys and girls in that walk of life which seems most suited to their talents, attainments, and temperaments.

If carried to these culminating points, the work of the teacher will do more than anything else to bring about the full appreciation of the value of education, and with that there will come recognition of the importance of his office and the due reward for his services. G. H. J. Adlam.

THE SELOUS COLLECTION.

The Selous collection of big-game trophies, which has been presented to the Natural History Museum by Mrs. Selous, is, without doubt, the finest ever brought together as the product of one man's gun. It consists of some five hundred specimens shot by the late Capt. F. C. Selous, D.S.O., during a period of nearly forty years, some of the trophies dating from his earliest days as a hunter. The greater part of the collection is African, but there are many specimens from Canada, Newfoundland, the southern Carpathians, and Asia Minor.

Although the collection contains only a few actual "records," the average standard of the heads is very high, the series of Kudu being especially fine. The horns of the grandest specimen of this animal in the Selous Museum measure:—Length, (curve) $60\frac{5}{8}$ in., (straight) $45\frac{3}{8}$ in.; circumference, $11\frac{1}{2}$ in.; tip to tip, 33 in. It was shot in 1890, and Capt. Selous's diary contains an entry referring to this specimen:—"My joy may, therefore, be imagined when I saw that the most superb specimen of a koodoo bull that my eyes had ever looked upon lay dead before me." Another equally grand specimen is the skull with horns of the white rhinoceros from Mashonaland, a practically extinct species. This animal was shot in 1880, and Capt. Selous records that "the anterior horn is the longest for a bull" that he ever saw. There are sixteen specimens of lion, chiefly heads. A mounted specimen measures 9 ft. 11 in. in a straight line from nose to tail. The series of heads of wapiti, from Wyoming, U.S.A., includes several remarkable examples.

Mrs. Selous has also presented to the Natural History Museum the superb collection of European birds' eggs, every clutch in which was collected by Capt. Selous, and is labelled most carefully, with exact date and locality.

The specimens will in due course be removed from Worplesdon to South Kensington, and kept together as the "Selous collection" for a period of years.

FORTHCOMING BOOKS OF SCIENCE.

"A Manual of Meteorology," Sir Napier Shaw (part iv., "The Relation of the Wind to the Distribution of Barometric Pressure"); "Problems of Cosmogony and Stellar Dynamics," J. H. Jeans; "An Enquiry Concerning the Principles of Natural Knowledge," Dr. A. N. Whitehead; "Lectures on the Principles of Symmetry," Prof. F. M. Jaeger; "Advanced Lecture Notes on Light," J. R. Eccles (a sequel to the author's earlier work); the fourth and final volume of "Fossil Plants," Prof. A. C. Seward; "Days in My Garden," E. Ballard; "Study of the Weather," E. H. Chapman (Nature Study Series); "Cattle and the Production of Beef," K. J. J. Mackenzie; "Yorkshire, North Riding," Capt. W. J. Weston; "Dumbartonshire," Dr. F. Mort (each in the Cambridge County Geographies); "Euclid in Greek (Book i.)," Sir T. L. Heath; "Short History of Education," Prof. J. W. Adamson; and new and revised editions of "Elasticity," Prof. Love, and "Infinitesimal Calculus," Prof. Lamb (*Cambridge University Press*); "The Living Cycads," C. J. Chamberlain; "Problems of Fertilization," F. R. Lillie; "A Laboratory Manual of Elementary Zoology," L. H. Hyman; "A Source Book of Biological Nature Study," E. R. Downing; "The Function of Death in Human Experience," G. B. Foster; "Fourth Year Mathematics for Secondary Schools," E. R. Breslich (*Chicago: University of Chicago Press; London: Cambridge University Press*); "Locomotive Valves and Valve Gears," J. H. Yoder and G. B. Wharen; "Physical Laboratory Experiments for Engineering Students," S. Sheldon and E. Hausmann; "Hot Bulb Oil Engines and Suitable Vessels," W. Pollock; "The Manufacture of Chemicals by Electrolysis," A. J. Hale (Electro-Chemistry Series); and new editions of "Glass Manufacture," Dr. W. Rosenhain; "The Manufacture of Paper," R. W. Sindall; "Wood Pulp," C. F. Cross, E. J. Bevan, and R. W. Sindall; "Photography," by Alfred Watkins (Westminster Series); "Handbook for the Care and Operation of Naval Machinery," Commander H. C. Dinger (*Constable and Co., Ltd.*); "Souvenirs Entomologiques: Etudes sur l'Instinct et les Mœurs des Insectes," J. H. Fabre, édition définitive illustrée, 10 vols. (*Paris: Delagrave*); "Birds in Town and Village," W. H. Hudson (*J. M. Dent and Sons, Ltd.*); "An Introduction to Child Psychology," Prof. C. W. Waddle; "The Measurement of Intelligence," Prof. L. M. Terman (*G. G. Harrap and Co., Ltd.*); "Annals of the Philosophical Club of the Royal Society, Written from its Minute Books," Prof. T. G. Bonney; "Science and Fruit-Growing: Being an Account of the Results Obtained at the Woburn Experimental Fruit Farm since its Foundation in 1894," the Duke of Bedford and S. Pickering; "A Text-book of Embryology" (vol. iii., Mammalia), by the late Dr. R. Assheton, completed by Dr. F. H. A. Marshall and J. T. Saunders; "Lectures on Sex and Heredity," Prof. F. O. Bower, Prof. Graham Kerr, and Dr. W. E. Agar; "Essays on the Surgery of the Temporal Bone," Sir C. A. Ballance, with the assistance of Dr. D. Green; and new editions of "Mendelism," Prof. R. C. Punnett, and "On Longevity and Means for the Prolongation of Life," the late Sir H. H. Weber, edited by Dr. F. Parkes Weber, with a preface by Sir Clifford Allbutt (*Macmillan and Co., Ltd.*); "The Thermionic Valve in Radio-telegraphy and Telephony," Prof. J. A. Fleming; "The Oscillation Valve: The Elementary Principles of its Application to Wireless Telegraphy," R. D. Bangay; "Telephony without Wires," P. R. Coursey (*The Wireless Press, Ltd.*).

THE ROYAL SOCIETY CONVERSAZIONE.

PREVIOUS to the war the Royal Society held two conversaziones annually—one to which gentlemen only were invited, and the other at which ladies as well as gentlemen were present. These social meetings were resumed on May 28, when a distinguished gathering of men of science and others met at Burlington House for the usual first conversazione, after an interval of four years. Many exhibits of apparatus and objects of scientific interest were on view, and the subjoined descriptions of them are abridged from the official catalogue. Exhibits relating to like departments of scientific activity have been brought together, and only such descriptions have been included as can be comprehended without seeing the actual objects.

Prof. H. F. Newall: Dr. G. E. Hale's photographs of the Zeeman effect in the spectra of sun-spots. An image of the sun's disc is thrown by means of the 150-ft. tower telescope at Mount Wilson on the slit-plate of the 75-ft. spectrograph. Close to the slit a Nicol prism is placed. Above the Nicol prism are mounted strips of mica 2 mm. wide, with their axes inclined $+45^\circ$ and -45° to the length of the strips, alternating in adjacent strips. This device is called a compound quarter-wave plate. When a sun-spot near the centre of the sun's disc falls on the slit through the polariscopic apparatus, certain lines in the spectrum are widened, and others resolved into two or three components. From a comparison of the solar effects and of the magnitude of the Zeeman effect in experiments in the laboratory on the corresponding lines, the strength of the magnetic field in the sun-spot is deduced. Average spots exhibit fields ranging from 2000 to 2700 gausses. The field varies approximately in proportion to the size of the umbra.

Sir Napier Shaw: Illustrations of the structure of the atmosphere on selected occasions. (1) Records of wind, on tube-anemometers, corrected for the difference of exposure in different orientations. (2) Maps of stream-function of the air for different levels on the occasion of the destruction of a fleet of Zeppelins, October 19–20, 1917, and another similar distribution on October 13, 1918. (3) Theoretical maps of the stream-function of the free air and distribution of pressure in the case of a cyclone consisting of a simple vortex with maximum velocity 43 metres per second, enclosing a core of fluid-rotating-like-a-solid, in a uniform atmospheric current of 16 metres per second; with maps for 18h., September 10, 1903, for comparison.

Mr. George H. Gabb: Portrait of Dr. John Jeffries, in pastel, by John Russel, R.A. Dr. Jeffries was, with Blanchard, the first to cross the Channel in a balloon, on January 7, 1785. The account of this epoch-making "aerial voyage" was read before the Royal Society in January, 1786. This portrait was exhibited in the Royal Academy in 1786, and was lost for more than a hundred years until it was discovered a short time ago, quite unknown, among a miscellaneous collection of pictures. Dr. Jeffries was the first to make an ascent solely for scientific purposes, and the first to attempt meteorological observations from a balloon. In his ascent from London on November 30, 1784, he included in his scientific equipment a barometer, a thermometer, a hygrometer, an electrometer, a marine compass, a telescope, and six small phials filled with water given him by Cavendish in order to collect samples of air at different altitudes.

Prof. MacGregor-Morris: Portable apparatus for measuring air-currents. A Wheatstone bridge is made of four wires all exactly alike of a material the resistivity of which varies with temperature. This bridge is heated by the passage of an electric current. Adjacent arms are so arranged as to be unequally cooled when placed in an air-current. The apparatus can be carried on a bicycle, and has been used for determining the velocity of the wind about a cliff-edge, and also around the gallery of a lighthouse.

Royal Aircraft Establishment, Farnborough: Standard and research aeronautical instruments. (1) R.A.E. Mark II. Compass.—An instrument designed by the late Capt. Keith Lucas to avoid, so far as possible, the errors which occur when flying in a northerly course. (2) R.A.E. Accelerometer.—This instrument records the variations of apparent gravity on an aeroplane by photographing the movements of a fine glass fibre bent into a bow. (3) R.A.E. Kymograph.—The instrument is to record movements of the aeroplane in roll, pitch, or yaw. (4) R.A.E. Pressure-plotting Apparatus.—The apparatus records the pressure or suction over an aeroplane's wings by means of small pipes which open flush with the surface and lead to a multiple recording pressure-gauge. (5) R.A.E. Climbmeter.—An instrument which indicates the rate at which an aeroplane is rising or falling.

The Cambridge Scientific Instrument Co., Ltd.: Dr. G. A. Shakespear's katharometer for measuring the purity of gases. Two small spirals of platinum wire form two arms of a Wheatstone bridge, and their resistances, depending on their temperatures, depend on the viscosities of the surrounding gases. A galvanometer connected across the bridge indicates its out-of-balance, and is calibrated to give a direct reading of the purity of the gas, or otherwise, as required. Many practical applications are possible: (*a*) A hydrogen purity meter for use with aircraft is exhibited; (*b*) permeameters for testing airship fabrics and exploring seams or searching for leaks are exhibited; and (*c*) a humidity recorder showing the vapour pressure in the air of the exhibition room was shown working.

Mr. F. W. Aston: Rapidly moving striated discharge in neon and helium. The light in the capillary of a spectrum discharge tube containing neon or helium is apparently continuous, but when analysed by a rotating mirror is found to consist of a procession of alternate bright and dark bands or striations travelling in the direction of the current, *i.e.* from anode to cathode. These appear in the mirror as ribbons of light, their waviness indicating variations in speed and being more marked in neon than in helium. The mean velocity can be calculated from the slope, and is found to be approximately that of pressure-wave propagation, *i.e.* sound, in the gas in the discharge tube.

Mr. C. T. R. Wilson: (1) Stereoscopic photographs of the tracks of ionising particles through air. By causing water to condense upon the ions set free, the invisible trail of ions left by each flying particle along its course is converted into a sharply defined line of cloud. Stereoscopic photographs of the tracks thus rendered visible are taken before convection currents have had time to distort them. (2) Photographic record of the changes in the electric potential gradient during a thunderstorm. The record showed the sudden changes produced in the electric field by the passage of lightning discharges.

Prof. E. H. Barton and Miss H. M. Browning: Vibrations, forced and coupled. The phenomena of forced vibrations and resonance were experimentally illustrated by a number of pendulums of graduated lengths, with light bobs hanging from a horizontal cord and set vibrating by a pendulum, with heavy bobs hanging from the same cord. All the salient points of the mathematical theory of forced vibrations

(mechanical, musical, or electrical) were thus rendered simultaneously visible.

The National Physical Laboratory: Mechanical and optical apparatus for measuring and inspecting screw gauges (Metrology Department). A vertical projection machine shown produces an enlarged image of the profile of the thread on a diametral plane to a magnification of 50. This image can be compared with the standard form for the thread which is drawn out to the same magnification. Errors of 0·0001″ in the thread-form can be so detected.

Mr. A. Mallock: Apparatus used in the measurement of the growth of trees. An "invar" tape was passed round the tree and over the "rockers" on the apparatus, the arms of which control the angle between a plane glass surface and the face of a right-angled glass prism. The growth of the tree continually alters this angle, the variation of which was measured by observing the change of position of the interference bands formed, at grazing incidence, between the plane and prism. The details of the procedure are given in Proc. R.S., vol. xc. B, 1918, p. 186 *et seq.*

Prof. Ernest Wilson: Instruments for measuring minute susceptibilities, including a portable instrument for survey work. The action of the instrument depends upon the mechanical force exerted by a magnetic field on a magnetic material placed in it, the force per unit volume being proportional to the gradient of the square of the field. It is ultimately measured by a galvanometric method involving the action of a spot of light, except in the case of the portable instrument, when a pointer is more convenient.

The National Physical Laboratory: (1) Apparatus for the determination of the absolute viscosities of liquids at high pressures. (Designed by Mr. J. H. Hyde; method suggested by Dr. T. E. Stanton.) The apparatus consists essentially of a system of two horizontal (the upper one of capillary dimensions) and two vertical tubes forming a closed circuit of liquid under pressure, the lower half of the circuit containing mercury and the upper half the liquid under test. The system rests on a horizontal knife-edge, and is supported in a horizontal position by a spiral spring. On the mercury being displaced by a given amount, flow will take place round the circuit owing to the difference of head, and if the spring is so adjusted that its rate of extension is equal to the rate of change of head of the mercury, it is evident that flow of the liquid under test will take place through the capillary under a constant-pressure difference, and at a velocity which can be calculated from the rate of extension of the spring. (2) Three-electrode vacuum tube with circuits arranged to produce oscillations of telephone frequency. (Mr. F. E. Smith.) The apparatus consists of a three-electrode vacuum tube with appropriate inductances and capacities in the plate- and grid-circuits. The values of these are such as to maintain oscillations of audible frequency. By varying either inductance or capacity the frequency of the oscillations is varied. A coil coupled to the plate inductance with a telephone in circuit serves to make the note audible. By suitably choosing the inductances and capacities, frequencies from about twenty per second to several millions per second are readily obtained. (3) Plotting chronograph, thermal curves, and model relating to ternary alloys. (Dr. W. Rosenhain.) The chronograph was designed for the direct plotting of time-temperature observations in the form of "inverse rate" curves as required for the heating and cooling curves of metals and alloys. The constitution of a binary alloy system can be completely represented by a plane diagram, but for a ternary system a three-dimensional model is required. The model shown indicated the constitution of a part of the system zinc-copper-aluminium, including alloys rich in zinc, and containing up to 10 per cent. of copper and 15 per cent. of zinc.

Sir Robert Hadfield: Stereoscopic radiographs of large carbon electrodes. These electrodes are used in electric steel-smelting furnaces, the largest type being no less than 22 in. in diameter. For effective and economical working of the furnaces it is essential that the electrodes do not break and fall into the bath. The finer the structure of the electrode and the fewer the inclusions, the less does the possibility of breakage arise. The stereoscope showed four different types of electrodes which are largely used.

Major G. W. C. Kaye and Dr. R. Knox: The detection of defects in aeroplane timber by the X-rays. The best workmanship and the highest quality material are essential in aircraft construction. The X-rays readily reveal bad workmanship and hidden defects in the interior of laminated or box spars and struts which cannot be seen by ordinary visual examination. As wood is very transparent to X-rays the fluorescent-screen method of examination suffices for routine inspection.

The Munitions Inventions Department: War research on nitrogen fixation. For the past three years the research laboratory of the Munitions Inventions Department, constituted under the auspices of the Nitrogen Products Committee of the Ministry of Munitions, has been conducting experimental investigations on various methods for the fixation of nitrogen. The most important divisions of the work have been concerned with the synthesis of ammonia, the oxidation of ammonia and the preparation of nitrates, and the preparation and purification of hydrogen. Experiments illustrative of the work of three of the sections are shown.

Mr. A. Chaston Chapman: "Mineral yeast," used in Germany during the war for human food. The organism exhibited is very similar to, if not identical with, the so-called "mineral yeast" which was manufactured in Germany in considerable quantities during the war and used to supplement the bread ration. The organism is not a true yeast—that is to say, it does not belong to the genus Saccharomyces. It grows freely upon nutrient solutions at a temperature of 38°–40° C., forming a thick, greasy, crinkled film. It does not produce alcohol, and the time needed for a full crop is about thirty-six to forty-eight hours. The separated organism contains 50–55 per cent. of protein and about 5 per cent. of fat, expressed on the moisture-free material. It is entirely free from bitterness and has a pleasant flavour, suggestive of that of cream cheese. As a source of carbon, glucose or molasses answer well, and the organism is capable of supplying the whole of its nitrogen needs from ammonium salts—that is to say, it does not require any organic nitrogen. In addition to the above, phosphates must be present, and small quantities of potassium and magnesium salts.

Mr. J. E. Barnard: Methods of observing Spirochætes by dark-ground illumination. It is recognised that for the identification of Spirochætes, particularly *Spironema pallidum*, the method of microscopical observation known as dark-ground illumination is the most satisfactory. To employ it successfully certain optical principles must be complied with. Such organisms are always within the limits of microscopic resolution in the direction of their length, but are often beyond the limits in breadth. It follows that any granular contents are ultra-microscopic, and that these are seen only under certain conditions.

Dr. R. T. Leiper: Demonstration illustrating the

experimental transmission of Bilharzia infections of man. In Egypt nearly 50 per cent. of the population suffer from bilharziasis. Owing to the risk to which the troops were exposed, the War Office, in conjunction with the Medical Research Committee, authorised, in 1915, a special inquiry into the mode of spread and prevention of the disease. The exhibit illustrated some results. It was shown that the vesical and dysenteric lesions of bilharziasis are caused by two different species of worms: that these worms require fresh-water snails as intermediate host. *Bilharzia haematobia*, which infects the bladder-wall, undergoes metamorphosis in *Bullinus dybowski*, and *Bilharzia mansoni*, which infects the intestine, develops in *Planorbis boissyi*. The infective stage enters through the skin.

Dr. E. J. Allen (for the Marine Biological Association): Living marine animals, illustrating the fauna of Plymouth Sound. The specimens were arranged to illustrate the changing character of the fauna with changing physical conditions, such as depth of water, movement of water, nature of the soil, tidal exposure, and varying salinity.

Prof. E. W. MacBride: Artificially produced abnormal Echinoderm larvæ. (1) Specimens of larvæ of *Echinus miliaris*, with a hydrocœle (*i.e.* rudiment of a water-vascular system) on each side. This modification is produced by subjecting the larvæ when three days old to the influence of water of increased salinity, and then when a fortnight old re-transferring them to ordinary sea-water and feeding them up. (2) Specimens of larvæ of *E. miliaris* devoid of a hydrocœle, but with spines on both sides. These larvæ are produced by starving them between the ages of three and six days and afterwards feeding them up.

Mr. E. S. Goodrich and Mr. A. F. Coventry: Frog and tadpoles obtained by artificial parthenogenesis. Apparatus used and results obtained by the method devised by Prof. E. Bataillon in 1910, who discovered that unfertilised eggs of a frog will develop if removed from the oviduct and pricked with a very fine needle. Some 80 per cent. of the eggs so pricked undergo cleavage, a much smaller number pass through later stages of embryo formation, and a very small percentage develop into tadpoles and succeed in metamorphosing into frogs.

Mr. C. Tate Regan: Models of fishes illustrating adaptive modifications in related genera. (1) Epibulus (Labridæ) differs from Cheilinus in the extremely protractile mouth; associated with this are remarkable modifications of the skeleton; the long movable quadrate is unique among fishes. (2) Xiphasia (Blenniidæ) has the specialised characters of Petroscirtes (canines very large, gill-opening a small foramen), but differs in its eel-shaped form, with the tail long and tapering and the vertebræ increased in number from fewer than 40 to about 125.

Prof. E. B. Poulton: Families of the African *Papilio dardanus* (*merope*) with the female parents. All the families, from the following parts of Africa, include non-mimetic males and the female forms mentioned below:—(*a*) Two from West Africa, bred by Capt. W. A. Lamborn from mimetic black-and-white *hippocoon* female parents. Female offspring all *hippocoon* in one, half *hippocoon* and half the ancestral non-mimetic *dionysos* in the other—the mimetic females constant, the non-mimetic variable. It is probable that *hippocoon* is a Mendelian recessive, and that the male parent was a heterozygote combining *hippocoon* and *dionysos*. (*b*) One from the Sesse Islands, N.W. Victoria Nyanza, bred by Capt. G. D. H. Carpenter from a *planemoides* female, mimicking large Acræinæ of the genus Planema. The offspring include *planemoides* and, in larger numbers, *hippocoon*. Another from the Kagera River in ex-German East Africa just south of Uganda, bred by the same naturalist from a rare female form combining *planemoides* and *trophonissa*. The two female offspring belong respectively to these latter forms. (*c*) Three from the neighbourhood of Durban, Natal, bred by Mr. G. F. Leigh, from the three mimetic females of S.E. Africa—*hippocoon*, *trophonius*, and *cenea*. In all three families the commonest local form *cenea* was present in larger numbers than any other form.

Dr. J. S. Haldane: Army form of apparatus for continuous oxygen administration. In cases of poisoning by irritant gas, and in various other conditions, one of the main dangers is due to the fact that the partial pressure of oxygen in the lungs becomes inadequate to oxygenate the blood. It is, therefore, necessary to add oxygen to the inspired air until a sufficient degree of recovery takes place. With the help of a reducing valve and graduated tap, a constant stream of oxygen of the required amount is delivered into the small bag attached to the face-piece. This bag is emptied at each inspiration, none of the oxygen being wasted. The administration can thus be continued, if necessary, for several days, as the consumption of oxygen is reduced to a minimum.

Mr. Joseph Barcroft: The treatment of chronic cases of gas-poisoning by means of continuous inhalation of oxygen. A hospital consisting of three small wards, each made of glass, was established in the Cambridge Physiological Laboratory. A model of this was shown. In the glass rooms patients were placed each for five days; they were allowed out for exercise, etc., for about seven hours of each day.

Sir Almroth E. Wright, Mr. L. Colebrook, and Mr. A. Fleming. Methods employed in the study of wound infections. (1) Investigation of the part played by the white blood corpuscles. The experiments showed that white blood corpuscles collected from the blood *in vitro*, or freshly arrived in the wound, are capable of killing great numbers of microbes—and that they fail to do so if injured by drying, or if an excess of fluid enables the microbes to keep out of their reach. (2) Investigation of the part played by the blood fluids. The experiments showed that (i) the unaltered blood serum provides a very unfavourable medium for the growth of most of the types of bacteria met with in wounds, but that a few of these—notably the streptococci and staphylococci—can grow in it quite unchecked. (Sero-phytic bacteria.) (ii) If the blood serum is corrupted, as it is in a wound, by abolishing its anti-proteolytic property, all the other types of bacteria are enabled to grow freely. (Sero-saprophytic bacteria.) (iii) If the alkalinity of the blood serum is blunted off, as in the condition of acidosis which is associated with "shock," the gas-gangrene bacilli are enabled to grow freely.

Dr. G. Sims Woodhead and Dr. Varrier Jones: Quasi-continuous temperature recording apparatus for clinical use, and specimens of records obtained. The outfit consists of a resistance thermometer with compensating leads, a galvanometer with "bridge" and resistances, by means of which a wide range of temperature changes may be observed, and a Cambridge thread recorder, which gives a quasi-continuous (at half-minute intervals) and permanent record of the temperature of the human or animal body. This apparatus has been of use in determining the diurnal variations of temperature of normal subjects and in studying febrile conditions in disease, *i.e.* tuberculosis. Continuous temperature records for seventy-two hours are readily obtained.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Grace authorising the Vice-Chancellor to inform Mr. Fisher that the University would welcome a comprehensive inquiry into its financial resources and approving an application to the Government for an emergency grant pending such inquiry passed the Senate without opposition.

The generous offer of the British oil companies to present a sum of 210,000*l.* to the University for the endowment of the school of chemistry has now been formally made to the Vice-Chancellor by Mr. R. Waley Cohen on behalf of the donors. In conveying this offer Mr. Cohen indicates the wishes of the donors as to the general manner in which their gift should be applied. They understand that not more than half of the sum will be devoted to the extension of the present chemical laboratory, and that the remainder will be utilised for supplementing the funds at present available for the upkeep of the laboratory and for the payment of its teaching and research staff. It is their desire that as large a portion of the fund as possible should be reserved for endowment purposes, and as small a portion devoted to the building as the University may consider to be consistent with efficient equipment. Since they feel a very deep interest in the success of the scheme, they would be glad to have an opportunity of expressing their views in regard to it when it has been drafted in detail by the University authorities. Whilst their main object is that the University may be enabled to render great service to all scientific work, they trust that the connection which will thus be established between the school of chemistry at Cambridge and the oil industry may lead to the study in Cambridge of the chemical problems connected with mineral oil.

Mr. F. T. Brooks, of Emmanuel College, has been appointed a University lecturer in botany for five years from Midsummer, 1919.

Dr. Peter Giles, Master of Emmanuel College, has been elected Vice-Chancellor of the University for the ensuing academical year beginning October 1.

LIVERPOOL.—Col. J. G. Adami, F.R.S., professor of pathology, McGill University, Montreal, has been elected Vice-Chancellor of the University in succession to Sir Albert Dale, who retires at the end of September. Col. Adami was born in 1862. Educated at Owens College and Christ's College, and later fellow of Jesus College (Cambridge), he is a pathologist of the highest distinction. Since 1892 he has held the chair of pathology and bacteriology in the McGill University, Montreal. He is well known in Britain and oversea for his great experience in university affairs. His presence will be another link between Transatlantic and British universities. Col. Adami has served in the Canadian Army Medical Corps as Assistant Director of Medical Services, and is medical historical recorder for the Canadian Expeditionary Force.

LONDON.—Prof. G. Elliot Smith has been appointed to the University chair of anatomy tenable at University College. Prof. Elliot Smith graduated at Sydney, taking the M.D. with First Class Honours and University medal, and at Cambridge, where he was a fellow of St. John's College. He was formerly professor of anatomy in the Egyptian Government School of Medicine at Cairo, and since 1909 he has been professor of anatomy in the University of Manchester.

Major A. J. Allmand has been appointed to the University chair of chemistry tenable at King's College. In 1910 he was awarded an 1851 Exhibition scholarship, and has since worked with Prof. Haber at Karlsruhe and Prof. Luther at Dresden. From October, 1913, to Christmas, 1914, he was assistant lecturer and demonstrator in physical chemistry at Liverpool, and, after holding a commission in the Army, was appointed Chemical Adviser at Army Headquarters.

Mr. A. E. Richardson has been appointed to the University chair of architecture tenable at University College.

The report and recommendations of the general committee on degrees in commerce have been approved by the Senate; the syllabuses and draft regulations for the Intermediate Examinations and the outline syllabus for the Final Examination have also been approved. A commerce degrees committee, which includes business men representing various commercial interests, has been appointed, the duty of which will be to report on matters connected with degrees in commerce from time to time and to review the scheme annually.

The Senate has resolved that it is desirable to institute a degree of Ph.D. for internal students in the faculties of theology, arts, science, and economics for students who pursue a course of not less than two years of full-time research work (or its equivalent in evening work). No alteration is proposed to be made in the existing regulations for the M.A. and M.Sc. degrees for internal students as a consequence of the institution of the Ph.D. degree.

It has been resolved by the Senate to institute a chair of aeronautics tenable at East London College.

The following doctorates have been conferred:—*D.Sc. (Physics)*: Mr. E. A. Owen, an internal student, of University College, for a thesis entitled "Phenomena Attending the Passage of X-Rays through Matter." *D.Sc. (Economics)*: Mr. G. H. Scholefield, an external student, for a thesis entitled "A History of British Policy in the Pacific," and other papers. *D.Sc. (Chemistry)*: Mr. G. N. White, an internal student, of University College, for a thesis entitled "The Action of Chloroform on Certain Aryl Mercaptans in Presence of Caustic Soda."

Mr. Pember Reeves has resigned the post of director of the London School of Economics.

OXFORD.—The statute making Greek optional was passed in its amended form by Congregation on June 3. The ultimate decision now rests with Convocation, which body will give its vote on June 17.

Difficulties have arisen about the appointment of a Romanes lecturer, and it has been found advisable to suspend the lecture for the present year.

A decree has passed Convocation authorising the erection of a new class-room and preparation-room at the physiological laboratory.

DR. W. M. VARLEY, at present principal of the Swansea Technical College, has been appointed principal of the Brighton Municipal Technical College in succession to Dr. W. B. Burnie.

THE Goldsmiths' Company has offered the sum of 15,000*l.* to London Hospital for the endowment of a chair of bacteriology, to be known as the Goldsmiths' Company's chair of bacteriology.

AT a conference of the Universities of the United Kingdom, held in London on May 23, it was unanimously resolved:—"That this conference of British universities desires the representatives who are about to proceed to visit the universities of France to convey to them its cordial greetings and congratulations, and its desire for the growth and consolidation of their fraternal relations, in the interest both of humane learning and science and of international comity and progress."

LORD DURHAM was installed Chancellor of Durham University on May 31. The following honorary degrees were conferred:—*D.C.L.:* Lord Crewe, the Right Hon. J. R. Clynes, Sir George Newman, the Rev. Prof. G. Milligan, Prof. Arthur Thomson, and Prof. J. R. Morrison. *D.Litt.:* Lady Frances Balfour, Sir Martin Conway, and Prof. W. P. Ker. *D.Sc.:* Sir E. Rutherford, Sir G. T. Beilby, Prof. A. A. Herdman, and Prof. J. J. Welsh.

THE Manchester City Council has approved a new method for the selection of elementary-school pupils who are to continue their education in secondary schools. Hitherto the only candidates for admission to secondary schools have been the children of parents who have made an application for the privilege. In future all elementary-school children between eleven and thirteen years of age will be examined by their head teachers with the definite purpose of selecting those best qualified to benefit by secondary education. The examination will be partly written and partly oral. The written portion will consist of general papers in arithmetic and English, and will be the same in all schools. The parents of all selected children will be approached with the object of gaining their co-operation in sending forward the children's names as candidates for admission to secondary schools. A further examination will follow, upon the result of which scholarships will be awarded. There will be some 60,000 pupils to take the preliminary examination, and all who get 50 per cent. of the maximum marks will be judged fit for extended education.

THE number of employers who are interested in the education of their employees has been increasing gradually for a number of years, and has received a considerable impetus from the development of welfare work during the war and from the Education Act of 1918. Conferences were held in June, 1918, and February, 1919, and at a larger and more representative meeting held in London on May 28–30 an Association for the Advancement of Education in Industry and Commerce was established. The first president is Lord Leverhulme, with Sir Woodman Burbidge as vice-president, Mr. J. Knox (of Lever Brothers) as chairman of the executive committee, and Mr. R. W. Ferguson (of Cadbury Brothers) as secretary. The association includes in its membership many of the largest and most enterprising firms in the country. The objects are to encourage the provision of education in industrial and commercial undertakings, and to aid in the general advancement of education by conferences, the printing and circulation of information, and co-operation with other educational bodies. Many of the firms have already anticipated to some extent the Act of 1918 by the establishment of schools on their own premises, while others have already utilised, or propose to utilise, the facilities which local education authorities are willing to provide. The papers read at the conference and the subsequent discussion indicated that the training of young people in works, factories, offices, and business houses already instituted or desired was in no sense to be narrowed down to the special requirements of vocation. As one of the speakers put it: "A better workman was a secondary aim, but a logical conclusion"; and another remarked that "the problems of to-day were not so much those of industry as those of leisure." The clever boy or girl was to be encouraged; the less fortunate ones had equal rights and greater needs. On the second day the members of the conference were entertained at a garden-party by Lord Leverhulme at The Hill, Hampstead Heath, and were afterwards addressed by Mr. H. A. L. Fisher and Sir Robert Blair.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 22.—Sir J. J. Thomson, president, in the chair.—Prof. W. J. **Sollas**: The structure of Lysorophus as exposed by serial sections. As the precise position of Lysorophus, regarded by Broom as the most interesting vertebrate fossil discovered for many years past, still remained open to discussion, some nodules containing its remains were placed in the author's hands for investigation by serial sections. This work is now complete, and all the facts of the anatomy of the skull and vertebræ and the main features of the shoulder-girdle and fore-limbs are exposed with a precision and wealth of detail only otherwise to be looked for in a recent skeleton. It is now placed beyond question that Lysorophus belongs to an ancestral group of amphibians closely related to the Urodela. Among the striking primitive characters it retains may be mentioned the presence of a basioccipital and a supra-occipital bone, with a foramen in the former for the twelfth nerve, and possibly connected with this the presence of a large paired proatlas.—O. **Rosenheim**: A preliminary study of the energy expenditure and food requirements of women workers. Direct determinations (by the Douglas-Haldane method) of the energy expenditure of women were made during periods of rest, recreation, and work, the last referring to work on the lathe. By means of the data obtained an approximate estimate of the daily food requirements, expressed in Calories, was arrived at on the basis of certain considerations set forth in the communication. The results agree with those of previous workers obtained by indirect statistical methods.—M. **Greenwood**, C. **Hodson**, and A. E. **Tebb**: Report on the metabolism of female munition-workers. Observations were made upon forty-three women engaged upon twelve different processes in the manufacture of projectiles, the rate of metabolism being determined by the method of indirect calorimetry. Making the allowance for metabolic needs during non-working hours recommended by the Royal Society Food (War) Committee, the workers were found to fall into four classes, for each of which the daily net requirements per average woman were 2530 Calories, 2810 Calories, 3200 Calories, and 3425 Calories. The results were concordant with the inferences drawn from a study of food consumption in a large explosives supply factory during the war. The figures obtained in this experimental work were somewhat larger than those reached by Becker and Hämäläinen.

Royal Anthropological Institute, May 20.—Sir Everard im Thurn, president, in the chair.—Capt. A. M. **Hocart**: Early Fijians. Layers of culture have generally been distinguished and dated in a rather arbitrary manner. It is too often taken for granted that the rudest culture is the earliest. Fiji is an instance in point; it is usually assumed that its rudest tribes are its earliest inhabitants. The evidence is rather against that. Titles that once existed in eastern Fiji are now to be found in the more easterly groups of Samoa and Tonga. Samoan legends are full of references to Fijian immigrants. Fijian tribal traditions agree, being almost unanimous in placing their own original home in the northern hills of the main island in the west. Evidently there has been a general displacement from west to east. Linguistic remains show that Polynesian was once spoken in the east. Society was feudal and the chiefs divine. There was a dual chieftainship similar to the Japanese, and certainly a dual organisation, and so on. If we look outside Fiji we shall find the proper name of those islands, namely, Viti, occurring in Polynesian tradi-

tions and place-names. We must, therefore, recognise the existence of a people, the Vitians, who overspread the whole of Polynesia. They were driven eastwards by a barbaric invasion, which repeated some features of the invasion of Europe by the Germanic hordes. Hints of a similar cataclysm are to be found in Melanesia, and even so far west as Indonesia.

PARIS.

Academy of Sciences, May 12.—M. Léon Guignard in the chair.—G. **Humbert**: The measure of the classes of quadratic forms, ternary and positive, of given determinant.—L. **Lecornu**: The vortices of a fluid vein.—P. **Sabatier**, A. **Mailhe**, and G. **Gaudion**: The action of finely divided metals upon pinene vapour. Four metals were used in these experiments, copper, nickel, cobalt, and iron, and the results of the two first are given in detail. With copper as catalyst, aromatic hydrocarbons predominate; with reduced nickel at 600° C. the decomposition is very energetic, but as soon as the activity of the metal is reduced by deposited carbon the products are similar to those obtained with copper.—E. **Ariès**: Direct determination of the temperature exponent in the equation of state of fluids. A formula deduced in an earlier communication has been applied to the experimental data (Sydney Young) for seven substances, with satisfactory agreement.—M. Hilaire de Chardonnet was elected a member of the division of the applications of science to industry.—E. **Belot**: Spiral orbits with balanced gravitation.—C. **Chéneveau** and R. **Audubert**: The velocity of light in turbid media.—A. **Boutaric**: The application of the Gibbs-Helmholtz equation $A-U=T(\partial A/\partial T)$ to monovariant systems. It has been assumed by Nernst and others that for monovariant systems the above equation becomes $A-U=T(dA/dT)$, in which dA/dT is the differential coefficient of A (a function of T only) with respect to T. It is shown that, in general, this extension is not legitimate.—A. **Colson**: Eutectics and dilute solutions.—A. **Béhal**: The isolation and characterisation of alcohols as allophanates. The alcohol is converted into the allophanate by cyanic acid, produced in the gaseous state by depolymerisation of cyanuric acid, and the reaction product washed with ether to remove unchanged alcohol and urethane. All the allophanates are crystalline, very slightly soluble in ether, and serve well for the separation and identification of alcohols.—G. **Reboul** and L. **Dunoyer**: The influence of the seasons and the aerological systems on the correlative variations of atmospheric pressure and of the intensity of the wind.—J. **Braun-Blanquet**: The discovery of *Laurus canariensis* in the tufas of Montpellier.—P. **Bertrand**: Relations of the plant zones A_1A_2 and B_1B_2 with the marine levels of the Coal Measures of the North of France.—L. **Joleaud**: The *rôle* of the maritime channels of North Florida and South Caribee in the migrations of Tertiary and Quaternary mammals.—J. **Amar**: Pulmonary ventilation and hæmatosis.—J. **Pellegrin**: The ichthyological fauna of the eastern Sahara.—E. **Sollaud**: The first phases of embryonic development in *Leander squilla*.—L. **Roule**: The pigmentation of young salmon (*Salmo salar*) and its relations with the first stay in fresh water and the first migration to the sea.

DIARY OF SOCIETIES.

THURSDAY, JUNE 5.

ROYAL INSTITUTION, at 3.—Sir Valentine Chirol: The Balkans.

ROYAL SOCIETY, at 4.30.—Dr. P. Phillips: The Relation between the Refractivity and Density of Carbon Dioxide.—P. N. Ghosh: The Colours of the Striæ in Mica, and the Radiation from Laminar Diffracting Boundaries.—Dr. E. F. Armstrong and Dr. T. P. Hilditch: A Study of the Catalytic Actions at Solid Surfaces.

ROYAL SOCIETY OF ARTS, at 4.30.—Lord Montagu of Beaulieu: Aviation as Affecting India.

LINNEAN SOCIETY, at 5.—H. N. Dixon: Mosses from Deception Island, New Guinea.—Miss Alwin M. Evans: The Structure and Occurrence of Maxillulæ in the Orders of Insects.—Ernest E. Unwin: Notes upon the Reproduction of *Asellus aquaticus*.—The General Secretary: A Medallion Portrait of Carl von Linné, hitherto unknown; The Original Seal of the Society, in use from 1789 till 1803.

CHEMICAL SOCIETY, at 8.—W. H. Perkin: Cryptopine. Part II.—P. Blackman: An Isotonic (Isosmotic) Apparatus for comparing Molecular Weights. Part I.—V. Cofman: The "Active Substance" in the Iodination of Phenols.—N. V. Sidgwick: The Influence of Orientation on the Boiling-points of Isomeric Benzene Derivatives.—J. Senior: The Atomic Weight of Iodine, and the Discovery of a New Halogen.—H. Hepworth: The Absorption Spectra of the Nitric Esters of Glycerol.

FRIDAY, JUNE 6.

ROYAL INSTITUTION, at 5.30.—Sir E. Rutherford: Atomic Projectiles and their Collisions with Light Atoms.

SATURDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—J. M. Price: The Italian Front.

THURSDAY, JUNE 12.

OPTICAL SOCIETY, at 7.30.—S. D. Chalmers: The Recognition of Detail.

FRIDAY, JUNE 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 5.—B. Van der Pol, jun.: A Comparison of the Wave-form of the Telephone Current produced by a Thermal Detector and a Rectifier in the Heterodyne Reception.—E. Wilson and E. F. Herroun: The Magnetic Properties of Varieties of Magnetite.

MALACOLOGICAL SOCIETY, at 6.—G. C. Crick: *Ammonites navicula* (Mantell).—R. Bullen Newton: A Sandstone Cast of *Aturia aturi* (Basterot) from the Miocene of Western Australia.—A. S. Kennard and B. B. Woodward: The Generic Names for the Two British *Ellobiidae* [olim *Auriculidae*] *myosotis*, Draparnaud (=*denticulata*, Montagu) and *bidentata*, Montagu.—G. Despott: The Mollusca of Marsascirocco Harbour, Malta.—Tom Iredale: Notes on Polyplacophora. Part II.

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THURSDAY, JUNE 12, 1919.

CATALYTIC CHEMISTRY.

(1) *Catalysis in Industrial Chemistry.* By Prof. G. G. Henderson. (Monographs on Industrial Chemistry.) Pp. x+202. (London: Longmans, Green, and Co., 1919.) Price 9*s.* net.

(2) *Catalytic Hydrogenation and Reduction.* By Dr. E. B. Maxted. (Text-books of Chemical Research and Engineering.) Pp. viii+104. (London: J. and A. Churchill, 1919.) Price 4*s.* 6*d.* net.

BOOKS on analysis are legion. The ionic theory has helped the chemist to appreciate the anion and cation in electrolysis, but the term catalysis has only recently been deemed worthy of appearing on the title-page of a chemical text-book.

In the "Dictionary of Applied Chemistry," 1916 edition, issued by the same firm of publishers as that of Prof. Henderson's "Catalysis in Industrial Chemistry," there is no separate article on catalysis, the reader being referred to "Chemical Affinity" for the definition, whilst Dr. Maxted's "Catalytic Hydrogenation and Reduction" as a special branch of the wider subject received only indirect mention.

Both books are for the industrial reader, and show the rapid development of applied science without attempting to trace the growth of the fundamental idea from the early conceptions of Davy and Faraday, although Prof. Henderson has unearthed an early patent of Phillips in 1831 for the production of sulphuric anhydride from sulphur dioxide and oxygen through the catalytic action of platinum, which may be regarded as the precursor of the modern contact process as developed at Freiberg and by Squire and Messel in London. The Dobereiner lamp of 1822 was an early industrial application of a metallic catalyst to hydrogen oxidation, and the stability of hydrogen peroxide in presence of acids, as shown by Thenard in 1818, is still a commercial illustration of negative catalysis which should be added to Prof. Henderson's review.

If a catalyst is simply an unalterable substance which modifies the velocity of the reaction, all solvents must be looked at catalytically, as pointed out by Ostwald, and Prof. Henderson gives us his first catalyst water both in heterogeneous solution, as in the inversion of cane-sugar, and in a homogeneous gaseous system, as shown by Dixon in sparking dry carbon monoxide and oxygen. The work of Sabatier and his pupils on the hydrogenation and reduction of organic compounds has activated within the last decade an industrial development of those catalytic processes which involve the use of free hydrogen, so that at the present time they are yielding results of considerable commercial value which are not confined to the soap industries. Although these are sufficiently summarised in two of Prof. Henderson's chapters, they are much more interestingly elaborated in Dr. Maxted's little book of 104 pages.

Wielands' interesting work with oxygen-free palladium in order to differentiate between catalytic oxidation and dehydrogenation, as, for example, in the conversion of hydroquinone into quinone, is not referred to by Prof. Henderson, although its bearing on the function of water as a catalyst in carbon monoxide oxidation is important, and, as pointed out by Dr. Maxted, these results throw quite a new light on the necessity for, and *rôle* of, water in oxidation reactions generally.

The extended use of these hydrogenation processes has necessitated a consideration of the methods for manufacturing a suitable hydrogen free from poisons to benefit the equally important catalytic synthetic ammonia and nitric acid processes essential for the future explosive and fertiliser industries. It is remarkable that here, again, the interaction of water-gas and steam in presence of the right catalyst points the way to economic hydrogen production for these big catalytic industrial operations, so that, in the words of Berzelius, "it is proved that several simple and compound bodies, soluble and insoluble, have the property of exercising on other bodies an action very different from chemical affinity. I will call this force the catalytic force, and catalysis the decomposition of bodies by this force in the same way that one calls by the name analysis the decomposition of bodies by chemical affinity."

The two books are welcome additions to the literature of the subject. S. RIDEAL.

CALIFORNIAN GAME BIRDS.

The Game Birds of California. Contribution from the University of California Museum of Vertebrate Zoology. By Joseph Grinnell, H. C. Bryant, and T. I. Storer. (Semicentennial Publications of the University of California.) Pp. x+642+16 coloured plates. (Berkeley: University of California Press, 1918.) Price 6 dollars net.

THE game birds of all parts of North America are of special interest to residents on the other side of the Atlantic, since they, unlike so many of the Passerine forms of the country, are closely akin to those of Europe. Moreover, from our earliest years we have been attracted by a large number of the names. The Pilgrim Fathers used many picturesque expressions, and their descendants continue to do so. The "Heath Hen of Martha's Vineyard" makes us want to know who Martha was and all about her vineyard, while the "Prairie Chicken of the Foothills of the Rockies" might be the title of the villain of a melodrama. Thus we take up a book on Californian game birds with a predisposition in its favour.

In the present case the predisposition is thoroughly justified, but the work covers far more than what are most commonly known as

game birds, for it runs from ducks and geese to sandpipers, plovers, grouse, and doves, while it includes all that are sold as game in the local markets. It aims at furnishing full information, from collected records, often much scattered in print, from local sources, and from personal observation, to the game-hunter, the naturalist, the legislator, and those concerned in bird preservation; and with this object in view is compiled by three of the best ornithologists in the State, who have had the further advantage of the use of the unpublished papers of Mr. L. Belding on the birds of the region.

In a general review it is unnecessary to enter upon details of the special part of the work, relating to the particular species; but we may express our appreciation of the thorough way in which this is carried out, a way reminding us of Baird, Brewer, and Ridgway's "Birds of North America." A glossary and keys to the main groups and species are followed by full descriptions, not only of adults, but also of the young, while useful marks for identification in the field are added, to precede the excellent accounts of habits, distribution, and so forth.

Obviously the main object of the writers is economic; they devote their attention most closely to that point of view, and emphasise strongly the need for the protection of birds which form part of the food supply; they examine and list the local game laws, and study their effect on the preservation of species. Moreover, the work is issued as a publication of the University of California, with the important aid of its zoological collections, and also with the hearty co-operation of the Fish and Game Commission of the State.

The economic factors are thoroughly discussed under separate headings. A study of the list of laws, coupled with Federal regulations, will show the great importance attached to the subject of this book in the United States, where, more than in any other country, bird protection has become necessary, and, as a matter of fact, has been ungrudgingly granted.

A goodly number of line drawings are distributed throughout the letterpress to explain important points of structure, while sixteen coloured plates decorate the pages, though the coloration is perhaps scarcely up to the standard of the text. Nine are the work of the well-known artist, L. A. Fuentes.

WAR SURGERY.

Surgery at a Casualty Clearing Station. By C. Wallace and John Fraser. Pp. xi+320. (London: A. and C. Black, Ltd., 1918.) Price 10*s*. 6*d*. net.

MAJOR-GEN. CUTHBERT WALLACE and Major John Fraser have written a very interesting book. Gen. Wallace was consulting surgeon to the 1st Army, B.E.F., and remained in France during practically the whole war. His experience entitles him to discuss the various phases of casualty clearing station work, since he has seen the C.C.S. compelled, by the *force majeure* of war, to undertake and adapt itself to surgery, for which it was never originally intended, and for which it only gradually acquired the equipment and *personnel*. The idea that surgical operations could be performed near the firing line was not accepted at the beginning of the war. It was anticipated that casualties would be dressed and fed at the C.C.S., and sent to base hospitals for operative treatment. The appearance of gas gangrene on a widespread scale in wounds of all sorts, even the most trivial, made it imperative that the surgeon should be brought nearer to the fighting zone.

Delay of even a few hours meant loss of limbs and loss of lives. If, however, every wounded man could have his wound excised (not merely dressed, but the damaged tissues cut clean out) within a few hours of receiving his wound, gas gangrene was practically abolished. This question and its solution were not merely problems of academic interest to the surgeon; they were of vital moment to the authorities responsible for the Army as a fighting machine. A shortened period of invalidism is fully as important in maintaining the numerical strength of an army as is the keeping up of a supply of fresh reinforcements. The researches of Gen. Wallace and Major Fraser into the causes and methods of dealing with gas gangrene threw most valuable light on the whole subject. Chaps. iii. and iv., on "General Wounds and their Treatment" and on "Antiseptics," are particularly interesting in this connection. Although many antiseptics and their modes of application are described, the summary of all experience is probably contained in the last sentence of the following passage: "One may completely excise the wound, wash the wound surface with a fluid antiseptic, and immediately suture the wound, hoping to get healing by primary intention; it is possible that the washing with the antiseptic may even be omitted." Before the war ended probably no surgeon felt the least doubt that the ceremonial washing with an antiseptic could be omitted, and that the thing which mattered was the completeness of the excision.

The chapter on "Injuries of Bones" goes fully into the different types of splints in vogue, but the illustrations are singularly inadequate.

Abdominal wounds are excellently dealt with; the combined experience of the authors enables them to speak with judgment and authority. Injuries of the chest, of the head, and of the spine are carefully considered and discussed.

In the treatment of hæmorrhage it is interesting to notice the change in teaching as regards the application of the tourniquet. Gen. Wallace does not go so far as to say that the man who leaves a tourniquet on a limb is guilty of criminal neglect, but he points out the extreme dangers which attend anything more than a purely temporary use of this means of arresting hæmorrhage.

The closing chapter, on "Tetanus," describes one of the greatest triumphs of preventive medicine. In the early days of the war tetanus constituted one of the greatest terrors that the wounded man had to face and the surgeon to witness. The routine use of anti-tetanic serum as a prophylactic injection in every case of a wound or abrasion caused this dreadful complication to disappear almost entirely.

With the cessation of hostilities there will be less occasion to practise surgery as described in this book, but every medical officer to whose lot it may fall in the future to take part in any military campaign will be well advised to include Wallace and Fraser's handy little volume in his kit.

OUR BOOKSHELF.

A Star Atlas and Telescopic Handbook (Epoch 1920) for Students and Amateurs. By Arthur P. Norton. New and enlarged edition. Pp. 25+16 maps. (London and Edinburgh: Gall and Inglis, 1919.) Price 3*s.* 6*d.*

It is not surprising that a second edition of this work has been called for, remembering the growing interest in astronomy and the necessity that every follower of the science feels for a good star atlas. The first edition appeared in 1910, and we have no reason to depart from the opinion of its merits then expressed in these pages. Fifty years ago R. A. Proctor gave in the Monthly Notices (vol. xxviii., p. 188) the conditions with which a work of this kind should comply: (1) A moderate number of maps; (2) not too large for convenient use; (3) uniform in size and shape; (4) on the scale of an 18-in. globe at least; (5) with little distortion; and (6) with little variation of scale or area.

Mr. Norton's atlas contains eight double maps—that is to say, each forms a double-page opening of a book 11 in. by 9 in. Two of them cover a cap of 40° radius round each pole, whilst each of the remaining six covers a lune from 60° N. to 60° S. declination, about 5 hours of right ascension in width, the distance from pole to pole in the maps being about 23 in., from which it will be seen how well the first three of the above conditions are satisfied. Stars to the sixth magnitude, nebulæ, and clusters are shown to the number of more than 7000, and a feature that will appeal to many students of the heavens is the reference to catalogues of various kinds and other useful information given by the lettering.

It has not been found necessary to make any alteration in the maps, which are as they were in the first edition, but the prefatory notes have been considerably amended and enlarged. The addition of a paragraph on the classification of star spectra is to be noted, and another of a list of novæ, which includes that of last year. A small table of the effects of atmospheric absorption is now given, and the sketch map of the moon has been furnished with an index, both of which add to the usefulness of this moderately priced work.

Board of Agriculture and Fisheries. Guides to Smallholders. No. 1: *Pig-keeping*, pp. 32. No. 5: *Farm Crops*, pp. 32. No. 6: *Soils and Manures*, pp. 30. No. 7: *Fruit-growing on Small Holdings in England and Wales*, pp. 30. No. 9: *Potato-growing on Small Holdings*, pp. 32. (Board of Agriculture and Fisheries, 3 St. James's Square, S.W.1, 1919.) Price 2*d.* each.

It is always difficult to cater for smallholders because of their great variation; in their ranks are found many types of men, some fairly well educated, who, for one reason or other, have taken up farming late in life, while others are shrewd, capable labourers who have risen in the ranks, and, but for their lack of education, would long ago have been successful farmers on their own account. The booklets before us are designed particularly for the first type of men, but they will also prove helpful to the second.

The information is sound, and put in the colloquial form now so much in favour in extra-official publications. The soil is described in one place in Tull's picturesque phrase as "the pasture of plants"; it is elsewhere likened to "the plant's kitchen," and the organisms producing the useful nitrates are called the "domestics that serve the crops." "When the land becomes waterlogged things go wrong in the plant's kitchen. The unhealthy yellow colour of corn crops so often associated with cold weather in spring is not really so much due to cold as to epidemics among the 'domestics' and a stoppage of the plant's supply of food." Such descriptions at least show the cultivator that the soil is more complex than it seems, and must be treated with respect. The practical advice is quite good: the smallholder is told how much seed to sow, in many cases—especially fruit and potatoes—he is told what varieties to select from, and useful hints are given on the general management of the crop.

The publications are in the form of booklets of large postcard size, and they are well got up; they represent a serious attempt, which we hope will be successful, to help the smallholder on many of the technical points that are likely to trouble him.

Inorganic Chemistry. By Prof. James Walker. Pp. viii+327. Eleventh edition. (London: G. Bell and Sons, Ltd., 1919.) Price 5*s.* net.

Prof. Walker has recast his popular elementary text-book of inorganic chemistry. The general and systematic portions are in this edition less strictly separated. All the common elements now receive brief systematic treatment, and the theoretical sections have been enlarged. In its new form the book should be even more widely adopted than hitherto.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Wireless Telephony.

It may be of interest to state that the Marconi Co.'s demonstration at Chelmsford of wireless telephony on May 28, alluded to in NATURE for June 5, was clearly heard on wireless apparatus in this house. Every word could be clearly recognised, the speaking being most distinct and very loud. What was heard included the reading of several newspaper paragraphs, the playing of gramophone records, and some remarks by Mr. Godfrey Isaacs, in which he said that no one would be able to overhear the conversation, as it required very special apparatus to pick it up!

Since then other speech has frequently been heard and understood. This apparently emanates from some military wireless station, where the operator is addicted to long poetical quotations, which he declaims with much gusto.

It is quite fascinating to listen to these voices from the æther. A. A. CAMPBELL SWINTON.

40 Chester Square, London, S.W.1, June 6.

The Age of the Stars.

The arguments detailed by Mr. Poole (NATURE, April 3) relative to the astronomical tests of the suggestion that radiation passes only between bodies are essentially those I had in mind in remarking on the difficulties with "the ultimate trend of planetary temperatures." The ways of getting around these difficulties to me seem too artificial to make the "solid-angle" hypothesis a reasonable one astronomically, even though it may be the "rather preferable" type of selective radiation from the point of view of a corpuscular theory. The difficulties, however, might be removed, or at least much lessened, if only a diminution of radiation in the empty angle is postulated, for the diminution would probably be a function of temperature.

But the point I hoped chiefly to emphasise by the data and arguments in my former letter is that we now have various direct astronomical observations indicating that the sidereal time-scale is enormously longer than is generally acknowledged. If these results from studies of Cepheid variables and globular clusters, with the strong support of geological considerations, are accepted, I desired also to emphasise that the problem of accounting for the origin of stellar energy and for concomitant phenomena of radiation is of the highest importance, whether the solution involve denying that radiation at high temperatures is propagated uniformly regardless of material surroundings, or whether it lie in the discovery (or acceptable description) of other properly operative sources of energy—such, for instance, as might be provided by the "general physics" suggested by Mr. Jeans, which is to allow direct mass-energy transformations through setting aside the accepted principles of conservation.

HARLOW SHAPLEY.

Mount Wilson Observatory, Pasadena, California, May.

Globular Lightning.

As well-authenticated cases of globular lightning are comparatively rare, the accompanying note by Mr. Gilmore may be of interest to your readers. Mr. Gilmore is a research student working in this laboratory. He is at present engaged on a research dealing with the electric charge on rain, and when he saw the first luminous ball described in the note he had stepped outside his rooms to decide whether it was likely to rain soon. He then went to the laboratory and was busy with his observations during the thunderstorm. When the rain ceased he was standing at the door of the laboratory looking at the clearing sky, and then saw the second ball. In the circumstances, we must regard his observations as in every way trustworthy.

I should mention that I have met two other persons who claimed to have seen luminous balls during the same storm. Their descriptions were, however, rather vague. In neither of these two cases did the time agree with the times of Mr. Gilmore's observations. Taken in conjunction with Mr. Gilmore's observations, these further rather vague descriptions afford evidence that this thunderstorm was rich in phenomena of the globular lightning type. J. A. McCLELLAND.

Physics Department, University College, Dublin, May 28.

On the night of May 14 a thunderstorm took place over Dublin. A shower of rain fell after 9 p.m., but between about 9.25 and 9.40 there was practically no rain, only a few drops falling. At about 9.50 I went outside, and when I had gone about two steps from the door I suddenly saw a luminous ball apparently lying in the middle of the street. It remained stationary for a very brief interval—perhaps a second—and then vanished, a loud peal of thunder occurring at the same time. The ball appeared to be about 18 in. in diameter, and was of a blue colour, with two protuberances of a yellow colour projecting from the upper quadrants. It left no trace on the roadway. The street is about eight yards wide from footpath to footpath, with houses on both sides, the total distance across the street between the houses being about twenty yards. There are no tramlines on the street. When I observed the ball its distance from me was about ten yards. The thunder was heard just at the disappearance of the ball, but the sound seemed to come from overhead rather than from the place where the ball was. This was the first peal of thunder that I heard, and there was no more thunder or lightning until after 10.15. From 10.40 onwards the thunderstorm was rather violent and the rain heavy. The rain ceased about 12 midnight, but sheet lightning continued to play over the sky. I was looking towards the north at about 12.15, where the sky was fairly clear, with small white clouds scattered over it, when I saw a yellow-coloured ball which appeared to travel a short distance and then disappear. This ball was high up in the sky, and appeared smaller than the first ball described above.

G. GILMORE.

WAR AND WASTE.

War, however conducted, is, from its very nature, a wasteful business, and, if carried on *more teutonicum,* is flagrantly so. Nothing affronted the righteous instincts of civilised humanity more profoundly than the shameless and unbridled lust of destructiveness in which the Germans indulged so long as Belgium and Northern France remained within their grasp; and nothing has excited universal contempt so much as the way in which they are shuffling now they are compelled to make good, so far as is possible, the damage they so causelessly and wantonly inflicted.

But, considering what war is essentially and how it must be fought, whatever be the mentality of the combatants, there is a certain element of comedy in setting up an organisation during the actual course of a war in order to ascertain, not how the waste of war may be minimised, but how the waste of peace-time operations may be reduced or possibly altogether obviated. It is doubtful if any other nation than ourselves would have thought of such a consideration at such a juncture. But the Munitions Inventions Department, on the principle presumably of compounding for sins they were inclined to, created in 1918 a small Committee, under the chairmanship of the principal of the Heriot-Watt College, Edinburgh, to make inquiries concerning chemical waste products throughout the country, and to carry out investigations with a view to their utilisation. That waste should be obviated is a sound general proposition applicable at all seasons, but why the particular instances of it which engaged the Committee's attention should be specially urgent in 1918 is not very obvious, as they were wholly without bearing on the conduct of the war, and were of small importance from the point of view of economy, even in peace-time.

The Committee, however, has now reported,[1] and we may best learn from its own statements what it has accomplished, and what useful results are likely to follow from its labours. In the first place, the Committee communicated with the Association of British Chemical Manufacturers, inviting assistance in collecting information concerning chemical waste products, and later it sent out a circular letter to chemical manufacturers asking if they made any waste products not at present utilised, and, if so, what was their nature and quantity. Of those who replied, rather less than half stated that they had no waste products; 220 manufacturers said they had waste products, and indicated their character. The Committee gives a list of those brought to its notice—some sixty-eight in number. With one or two exceptions, they arise in old-established industries, and are in no wise connected with the war.

In its circular letter the Committee stated that one of its objects was to save overseas tonnage. It is difficult to see how the consideration of the special instances brought to the knowledge of the Committee would even appreciably influence the tonnage question. Perhaps the subject of waste materials for paper-making is the best example that could be quoted, considering the admitted shortage of such materials during the later periods of the war. The Committee accordingly directed its attention to two unutilised products, viz. spent mimosa bark—a residue from the tanning industry—and the waste wood due to the felling of timber trees in this country. With the assistance of Prof. Huebner, of the Manchester Technical College, the Committee is able to report that it is possible to make brown paper from waste mimosa bark, as, indeed, might have been anticipated, and this fact was communicated to the tanners using the bark, as well as to the paper manufacturers, but it does not appear that any practical result has followed. Nor did anything practical follow from the investigation into the possible use of scrap timber.

It was scarcely necessary to make an experimental investigation in order to arrive at the decision to which the Committee came. Inquiry from the trade showed that the cost of the necessary plant, combined with fuel conditions and uncertainty as to the duration of the war, rendered it inexpedient to recommend any extension of the existing means in this country of using wood pulp in the manufacture of paper—a conclusion which might have been foreseen without the formality of a special Committee. At the same time, the Committee states it is in a position to supply information as to shredding plant, and will communicate to those who may be interested the results of Prof. Huebner's investigations into the best conditions both for boiling soft waste wood from pine, birch, and oak, and for treatment with caustic soda.

The Committee further reported on the recovery of the chemicals used in discarded gas helmets; on the utilisation of the maize residues in the manufacture of butyl alcohol, which were found to be unsuitable for cattle food, but could be used as a fertiliser; on the possible use of sphagnum moss as a cattle food—an inquiry eventually handed over to the Food Production Department; and on the utilisation of waste chrome-tanned leather, dealt with by Mr. Lamb, of the Leather Sellers' Technical Institute, who devised a process for converting it into glue.

The de-arsenication of oil of vitriol made from pyrites results in the accumulation of considerable quantities of arsenic sulphide in a form troublesome to deal with. The Committee caused experiments to be made as to the best method of treating this product with a view to the recovery of arsenic from it, and with outside assistance worked out a process which it supplied to those chemical manufacturers who asked for information concerning it. It is not stated whether the process has found application in chemical industry.

In the treatment of bauxite for the manufacture of aluminium a large amount of ferric oxide is left, for which only a limited use has been found. Its application to the purification of coal-gas naturally suggests itself, and a number of patents for this purpose have been granted, but with no very satisfactory result.

The Committee has taken up the problem, but is not yet in a position to report concerning it.

The use of burnt pyrites in the manufacture of oil of vitriol also suggested itself to the Committee as a possible gas-purification material, but, as might be anticipated, few samples were found to present the proper physical condition for em-

[1] Munitions Inventions Department. Report on the Investigations carried out by the Chemical Waste Products Committee.

ployment in the purifiers. Certain of the samples resulting from the operations of the Gas Light and Coke Co. were, however, found to give excellent results, and Dr. Evans, of the South Metropolitan Gas Co., is at present engaged in their further investigation.

Ferric hydrate precipitated by lime from the acid liquors used in the pickling of iron in the tin-plate and galvanising industries is also capable of being used in gas-purification. The utilisation of the waste pickle has been the subject of many patents, and various processes are in use, especially in the Midlands.

Attempts were made to recover selenium from the flue-dust from pyrites burners, and the residues from the Glover towers and vitriol chambers, but with no practical result. The amount in the flue-dust was found to be negligible, whilst that in the Glover tower and chambers varied between 0·3 and 0·7 per cent. In some exceptional cases it was as high as 4 per cent.

Other subjects which received the attention of the Committee were so-called bichromate of soda residues—that is, the residues left after the oxidation of organic substances by sodium bichromate and sulphuric acid; the residues from the manufacture of acetic anhydride; the tarry residues obtained in the rectification of benzol; residues containing calcium sulphate; residues from the manufacture of brucine; peat-tar residues, etc. But no specific information is given concerning the results which have been obtained, or as to the extent to which industry has benefited by the Committee's attempts to utilise these waste products.

It will be obvious from this summary that the Committee has been able to deal with only a few of the large number of such products brought to its notice, and of these few it remains to be proved that any results of permanent value have been obtained. Other inquiries are in progress, and it is suggested by the Committee that it should be developed into a permanent organisation similar in character to that of the National Physical Laboratory, with an Advisory Committee in association with a director and chemical staff with its own laboratories.

Of course, it is conceivable that the work of such an organisation might be largely extended, and that an institution might be created to subserve the higher interests of chemical technology. But the report of the Committee affords no evidence that results at all commensurate with the expense of such an institution are likely to accrue. Indeed, it may be questioned whether the kind of subjects with which it has concerned itself should fall to the cost of the taxpayer. It is primarily the duty of the manufacturer to deal with the by-products of his industry. He will utilise them if he sees that it is to his advantage to do so, and it is surely not the business of the State to teach him how to do it. In some cases there is no reasonable hope that these products are capable of being utilised, but in that event the expense of getting rid of them is no proper concern of the taxpayer.

Practically all the subjects to which the attention of the Committee was directed, in response to its circular letters for information, are long-standing problems which have taxed the energies of chemists and chemical engineers for many years past, and where men of proved technical skill have failed it is scarcely to be expected that a Committee constituted like that which has now reported will succeed. Committees are, in fact, cumbrous organisations to deal with questions of this character, unless, indeed, they are of the single-member type, which a bureaucratic Committee seldom or never is.

EDUCATION: SECONDARY AND UNIVERSITY.[1]

"WE end where we began; with an appeal to educational enthusiasts to temper their enthusiasm with charity. Let the advocates of classics, of history, of natural science, try, while exalting the value of their own subjects, to avoid reflections which hurt the feelings and provoke the opposition of the advocates of other subjects." Such is the exhortation with which Sir Frederic Kenyon concludes his interesting pamphlet, which embodies a report of conferences between representatives of literary, historical, and scientific aspects of education. Such aspirations may well receive sympathy and approval from all liberal-minded people, while they recognise that final agreement on all points under discussion has not even yet been reached.

A few only of these questions can be referred to here. Most people would be disposed to agree with the view that "universities have the right to require that every student who enters them shall be intellectually qualified to profit by the education which they offer," and it is to be hoped that this condition will be made practically operative. It is true that all young minds do not develop at the same rate, and many a boy or girl supposed to be dull at school has shown at maturity unexpected activity and powers. But with the present sufficient choice of subjects and methods the age of eighteen or thereabouts should afford time for the display of sufficient of those qualities which justify the admission of the student from the school stage to the university stage of his education. There has been too much of this in the past, with corresponding waste of educational resources and effort, and it has yet to be fully recognised that all young people are not inclined to intellectual pursuits, and for those who are not so disposed there is plenty of other useful work to do. "Common sense appears to indicate that a student should show some aptitude for a subject before he embarks on a university course of education in it."

1 "Education: Secondary and University." A Report of Conferences between the Council for Humanistic Studies and the Conjoint Board of Scientific Societies. By Sir Frederic G. Kenyon. Pp. 47. (London: John Murray, 1919.) Price 1s. net.

"Historically," it is said, "there is no doubt that the institution of examinations did much to raise the standard of education in this country in the last century. It is equally certain that, while they are good servants, they are bad masters." There is no doubt that schoolmasters chafe because all schools do not teach the same subjects along the same lines, and when a general examination is set some inequalities are imposed. This in many cases, however, implies lack of care or skill on the part of the examiners rather than inapplicability of the examination test.

The object of the conference, however, was to advocate principles, without formulating details, and concessions from both sides will help towards progress. Thus the suggestion that candidates for science scholarships should offer an historical or other literary subject as subsidiary to their main one is met by a resolution in favour of allowing a knowledge of science to count in history scholarships. This is quite as it should be, for the ignorance of literature and philosophy displayed by men of science in the past could only be matched or surpassed by the ignorance of the literate, not only of the physical world and the details of life around them, but also of all the great conclusions of science concerning man's origin, nature, and destiny.

Another subject dealt with by Sir Frederic Kenyon is the question of the relation of school to university and the shortening of school life. Notwithstanding some difference of opinion between Sir J. J. Thomson's committee and the conference, there is reason for thinking that many of the great schools possess both staff and apparatus which qualify them to carry out effectively the work undertaken in the first year of a university course. "The student," says the conference, "on coming to the university should come under the influence of the great teachers of the subject (instead of being placed, as is sometimes the case, in the hands of junior lecturers or demonstrators), and should be inspired with the views and the spirit of those teachers." What, then, it may be asked, is the use of a junior staff if it is not to be employed, and what was the advantage to the mass of undergraduates of the majority of the great men of the past, whose teachings they were unable to follow? Clerk Maxwell, Stokes, Kelvin, and others who might be named were not, and could not be, appreciated by more than the select few, and by them chiefly for the sake of general illumination rather than for specific instruction. Historical and literary subjects afford a better field, but originality is sometimes bewildering to the beginner, and the professor eminent in research is the best leader in most subjects only when the student is able to follow at the same pace.

The report affords interesting reading, and it contains an appendix which gives a summary of the main facts regarding the distribution and value of scholarships to the universities, with suggestions which will doubtless lead to further consideration.

SIR BOVERTON REDWOOD, BART.

SCIENCE and the petroleum industry have suffered a severe loss in the sudden death of Sir Boverton Redwood, Bart., which occurred at his residence, The Cloisters, Avenue Road, Regent's Park, on June 4. Despite his profound knowledge of the subject he had made his own, Sir Boverton Redwood will perhaps be best remembered by those of us who had the privilege of being associated with him in any of his numerous interests for the charm of his individual personality. The unique position he occupied in the petroleum world was doubtless in large measure due to this personal attraction, which, as chairman of committee, or as witness, or in mere friendly discussion, exerted an influence the value of which in giving expression to his views it would be difficult to over-estimate. His death leaves a blank which it is safe to say will never be completely filled.

Born in April, 1846, Sir Boverton was in his seventy-fourth year when he died—an age which would have fairly justified his retirement from active work. This, however, was the last thing he desired, and it is more than probable that the strain of four years of war, during which he gave of his best to the Admiralty and to the Petroleum Executive, seriously reduced his power of resistance to the illness to which he succumbed.

It was in the year 1869 that, as a young analytical chemist, he was appointed secretary of the Petroleum Association and thereupon determined to specialise in this subject. That he was soon recognised as a leading authority is evidenced by his appearance in 1872 as a witness before a Select Committee of the House of Lords; and a few years later, when it was decided to replace the somewhat untrustworthy open "flash-point" testing apparatus by the Abel instrument, it was Boverton Redwood who, by a series of more than a thousand separate tests, demonstrated that the equivalent of the existing legal standard of 100° F., open test, was, by the new close test, 73° F., and this figure was adopted in the amending Act of 1879. In 1883 he accompanied Sir Vivian Majendie in an extended tour on the continent of Europe to study the methods employed by foreign Governments in dealing with the storage of petroleum oil and spirit, and a few years later he paid a similar visit to the United States. There was, indeed, scarcely an oil-bearing district in the world that he had not visited.

For many years Sir Boverton was technical adviser to the Corporation of the City of London and to the Port of London Authority, and honorary adviser to the Home Office, the Admiralty, the India Office, and the Colonial Office, and in 1912 he was appointed a member of the Royal Commission on Oil-fuel presided over by Lord Fisher. He had already served as a member of the Committee appointed by the Home Secretary in 1908, with Sir Henry Cunynghame as chairman, to report on the existing legislation regarding petroleum spirit.

In 1896 Sir Boverton made a most valuable contribution to the industry he had so much at heart by the publication of his great work, "A Treatise on Petroleum." This has already passed through three editions, and a fourth was in course of preparation at the time of his death. He was also primarily responsible for the foundation of the Institute of Petroleum Technologists, of which he was the first president. In 1873 he married the eldest daughter of the late Mr. Frederick Letchford, who survives him. His only son, Bernard Boverton, died in 1911, leaving a son, Thomas Boverton, born in 1906, who now succeeds to the baronetcy. A. C. K.

NOTES.

AMONG the additional honours conferred on the occasion of the King's birthday we notice the following:—*G.C.B.:* Sir H. Llewellyn Smith, Secretary, Board of Trade. *K.C.B.:* Mr. Stanley M. Leathes, First Civil Service Commissioner. *C.B.:* Mr. R. J. G. Mayor, Principal Assistant Secretary (Universities), Board of Education, and Prof. S. J. Chapman, Senior Assistant Secretary, General Economic Department, Board of Trade. *Knight:* Col. G. P. Lenox-Conyngham, Superintendent of the Trigonometrical Survey, Dehra Dun, India.

THE following medical men are among those whose names are included in a list of further honours and appointments made on the occasion of the King's birthday:—*K.C.B.:* Col. W. Taylor and Lt.-Gen. Sir W. Babtie. *K.C.M.G.:* The Hon. Sir John McCall (Agent-General in London for the State of Tasmania), Col. W. T. Lister, Major-Gen. H. N. Thompson, Brig.-Gen. J. Moore, and Major-Gen. Sir W. P. Herringham. *K.C.V.O.:* Mr. J. O. Skevington. *K.B.E.:* Col. H. A. Ballance, Col. R. H. Firth, Col. C. G. Watson, Major-Gen. G. B. Stanistreet, Col. H. Davy, Lt.-Col. and Bt. Col. G. Sims Woodhead, Lt.-Col. Sir S. F. Murphy, Lt.-Col. D'Arcy Power, Lt.-Col. J. L. Wood, Lt.-Col. H. McI. W. Gray, Lt.-Col. Sir A. W. Mayo-Robson, Col. C. J. Symonds, Maj. and Bt. Lt.-Col. F. W. Mott, F.R.S., Major-Gen. Sir Robert Jones, Lt.-Col. A. D. Reid, Col. H. G. Barling, and Col. J. Swain.

AIRCRAFT crews are speeding up for the eastward flight across the Atlantic, and, weather permitting, fresh attempts will be made very shortly. The *Times* of June 10, in a cablegram from St. Johns (N.F.) dated June 9, says:—"The Vickers-Vimy machine ascended for its trial flight at 8.17 a.m. (Greenwich mean time). It descended after a spin of about forty minutes. . . . The airmen report that everything was working satisfactorily. . . . The machine will now await suitable weather for the Atlantic flight." The crew of the Handley-Page machine had earlier expressed the hope to be ready for the flight by June 15. There is the advantage now of the full moon. At the time of going to press the weather conditions over the eastern Atlantic were not very favourable. There were cyclonic disturbances in the Atlantic at no great distance from the Irish coast. If the aeroplanes which are being prepared had been ready on June 3, they would probably have experienced very favourable weather for the flight. At St. Johns a very light north-east wind was blowing and the weather was clear. During the night of June 3–4 no wireless weather message from the open Atlantic reported more than a fresh wind, and the direction was uniformly from the westward. There was a good deal of cloud with some rain and mist on the British coasts, which seemed the only unfavourable factor. "The Life-History of Surface Air-Currents," published by the Meteorological Office, giving the trajectories for mid-June, 1883, from some Atlantic synchronous charts, shows the surface wind from Newfoundland to travel up the Davis Strait and down to the eastward of Greenland, striking fairly southwards to the equator, so that all June weather is not favourable to the trans-Atlantic flight. Current weather conditions alone can be of use for safe guidance.

THE thirtieth annual conference of the Museums Association will be held in the University Museum, Oxford, on July 8–10, under the presidency of Sir Henry Howorth. The chief subjects for discussion are the question of transferring the control of museums to the education authority and the desirability of a diploma for museum curators and the necessary course of training. Among papers with a scientific bearing will be "Suggestions for Preparing and Mounting Museum Specimens," by L. P. W. Renouf; "The Pitt-Rivers Museum," by H. Balfour; and "Timber Collections for Museums," by H. Stone. Prof. Sollas will demonstrate the arrangement of the geological collections and his section-cutting machine, Prof. Poulton will elucidate the collections in his care, and contributions are promised by Prof. J. L. Myres and Dr. H. M. Vernon, among others. Visits will be paid to other museums and places of historic interest in Oxford. Each museum subscribing one guinea may send three delegates, and individuals can join on payment of half a guinea. The secretary (whose resignation we regret to see announced) is Mr. W. Grant Murray, Art Galleries, Swansea, and the local secretary, to whom inquiries about accommodation should be addressed as soon as possible, is Miss W. Blackman, of the Pitt-Rivers Museum, Oxford.

THE joint session of the Aristotelian Society, the British Psychological Society, and the Mind Association, to take place at Bedford College on July 11–14, promises some communications of present scientific interest. Dr. Rivers will expound a new theory of the repression of instinct in normal conscious life, to which he has been led in the study of war neuroses in the military hospitals. He is to open a symposium on "Instinct and the Unconscious," in which Dr. C. G. Jung, the leader of the Zurich school of psychopathology, will take part. The important neurological discoveries of Dr. Head will also be discussed in their bearing on the metaphysical problem of the nature of the ultimate data of science. This symposium will be presided over by Sir J. Larmor. It will be opened by Prof. Whitehead, who, with Sir Oliver Lodge and Prof. J. W. Nicholson, will represent different views on the questions raised by the recent relativity and quantum theories. In pure philosophy Mr. Bertrand Russell will expound a new view of what propositions are and how they mean, the result of a recent critical examination of the new behavourist psychology. Lord Haldane is to preside over a symposium on the relation of the finite to the infinite mind, which the Dean of Carlisle will open, and in which the Bishop of Down will take part. The theory of knowledge will be discussed in a symposium on "Knowledge by Acquaintance," at which Prof. Sorley will preside. The arrangements announced in the programme do not exhaust the interest of the session, as there are to be informal meetings for the reception of short communications and discussions on present controversies.

THE ladies' *soirée* of the Royal Society will be held at Burlington House on Wednesday, June 25, at 8.30.

THE general board of the National Physical Laboratory will meet at Bushy House, Teddington, on Tuesday, June 24.

DR. J. J. SIMPSON has been appointed keeper of zoology in the National Museum of Wales, and Dr. Ethel N. Thomas keeper of botany.

THE Bakerian lecture of the Royal Society will be delivered on June 19 by the Hon. R. J. Strutt, F.R.S., on "Phosphorescence and Fluorescence in Metallic Vapours."

WE regret to announce the death on June 10, at sixty-nine years of age, of the Ven. William Cunningham, D.D., Archdeacon of Ely, and fellow of Trinity College, Cambridge. Dr. Cunningham was the author of a number of important works on the economic aspects of the history of commerce, and from 1891 to 1897 was professor of economics at King's College, London.

IT is announced in *Science* that the Edison medal for meritorious achievement in electrical science or electrical engineering has been awarded to Mr. Benjamin G. Lamme, of the Westinghouse Electric and Manufacturing Co., and was presented to him at the recent annual meeting of the American Institute of Electrical Engineers.

WE learn from the *Times* that an International Hydrographic Conference will meet in London on June 24. The conference will be representative of all maritime nations, except the Central Powers, Turkey, and Russia, and it is hoped that the hydrographic experts will settle many differences in respect to charting, hydrographic publications, and hydrography generally.

THE following have been nominated as officers and council of the Wild Bird Investigation Society for the year 1919–20:—*President:* Mr. J. H. Gurney. *Vice-Presidents:* Dr. F. G. Penrose, Prof. D'Arcy W. Thompson, and Mr. E. Wheler-Galton. *Council:* Mr. W. Berry, Mr. L. Greening, Mr. L. A. L. King, Dr. S. H. Long, Dr. Graham Renshaw, and Dr. F. Ward. *General Secretary and Editor:* Dr. W. E. Collinge.

THE presentation of the Albert medal of the Royal Society of Arts to Sir Oliver Lodge on June 6, "in recognition of his work as the pioneer of wireless telegraphy," has given much gratification to men of science. The developments of wireless telegraphy have been so remarkable that the early demonstrations of its practicability by Sir Oliver Lodge are likely to be forgotten except by the people who witnessed them. We are glad, therefore, that the Royal Society of Arts has by its award given public recognition of his pioneer work, and has distinguished itself by being the first to confer an honour so fully merited.

ON account of the very large number of applications that have been received by the organising committee of the forthcoming British Scientific Products Exhibition, to be held under the auspices of the British Science Guild, all the space available at the Central Hall, Westminster, has now been allotted, and no further applications can be considered. The exhibition will be open to the public from July 3 to August 5. Its scope will be more extensive than was possible at last year's display, when war conditions made it necessary to withhold from public view much of the scientific and technical work carried on in Great Britain. Striking testimony will be furnished of the enterprise of British manufacturers, and the uses they have made of science and invention in new industries and in the development of old.

A COPY of the annual report for 1918 of the council of the Philosophical Institute of Canterbury, New Zealand, has been received. From it we learn that early in the year the Government voted the sum of 500*l*. to the New Zealand Institute for research work. Five applications for allotments were made through the Institute of Canterbury, and the following grants were made to members:—200*l*. to Dr. W. P. Evans, for investigation of New Zealand brown coals; 50*l*. to Dr. Chas. Chilton, for investigation of New Zealand flax (phormium); and 30*l*. to Mr. L. J. Wild, for a soil survey of the Canterbury Plains district. The principal action of the institute in the direction of the co-ordination of science and industry during the past year led to the establishment by the board of governors of Canterbury College of a technological section in the public library. The need for modern technical literature has been felt very much during the past four years by those engaged in the many attempts to establish industries of a chemical, or more or less scientific, nature. This section, though yet small, will, if adequately supported, eventually prove of great industrial value. The institute's representative on the board of trustees of the Riccarton Bush reports that the Bush has been open to the public during the year at the usual times, and has been visited by large numbers. The Bush continues to be of great use to the botanical students in the neighbourhood of Christchurch and to members of the institute.

THE preparation of lac, one of the oldest Indian industries, has recently been investigated by the Imperial Government. Though other countries, notably Japan and German East Africa, have attempted the cultivation of lac, their efforts have so far proved fruitless, and India retains the monopoly of this important industry, which supplies exports amounting to 4 crores of rupees, or about 260,000*l*. The collection of the product is still largely confined to the wilder forest tribes, and their methods are careless, imperfect, and wasteful. The same may be said of the present methods of making shellac. There is a real danger that it may be replaced by a synthetic product, and the example of indigo shows the possibility that the industry may ultimately disappear. Not long ago the forest chemist at Dehra Dun worked out a method of extracting the pure lac-resin with a wood spirit. This and other suggestions for improvement of the manufacture are now being considered by the Government of India, and there seems reason to anticipate that, in the immediate future, India will be able to meet the ever-increasing demand for shellac.

A COMPREHENSIVE paper on the Orthoptera of Nova Scotia has been recently published by Mr. H. Piers (Proc. and Trans. Nova Scot. Inst. Sci., vol. xiv., part 3, 1918). In addition to careful diagnoses of the twenty-eight species enumerated, the author gives valuable distributional, bionomic, and economic notes. It is rather surprising that, with the exception of the imported cockroaches, no member of the Nova Scotian orthopteran fauna is found in Great Britain.

MR. W. DWIGHT PIERCE has published (Proc. U.S. Nat. Mus., vol. liv., No. 2242) a second supplement to his monograph on the Strepsiptera. He brings forward additional arguments for his contention that

these curious parasites should be regarded as a distinct order of insects, describes their effects on various hosts, gives important morphological details (especially of the fascinating triungulin larvæ), and furnishes the student with extensive systematic revisions, including a diagnostic table of all known female Stylopidæ and a new summary of the geographical range of the 166 species of the order at present recognised. Of the sub-regions of A. R. Wallace, the South African, Siberian, Chilian, and New Zealand are still without records of these insects.

WE have received the seventy-ninth annual report, for the year 1918, of the Crichton Royal Institution, Dumfries—a mental hospital. With regard to admissions it is noted that there was a distinct increase in the proportion of cases attributed to such factors as emotional stress, overwork, and bodily ill-health, and a progressive decrease in the proportion of alcoholic cases. Influenza also accounted for some admissions. Various experiments on potato-growing, cattle-breeding and feeding, and sugar-beet growing were conducted at the farm. The institution possesses a completely equipped meteorological station, and a summary of the observations and records for 1918 is included in the report.

AN interesting paper on X-ray demonstration of the vascular system by injections is contributed by Mr. H. C. Orrin to the March issue of the *Archives of Radiology and Electrotherapy* (No. 224). It is claimed that such radiographs would be of the greatest value in the study of anatomy, showing the relative positions of various structures in a manner impossible by dissection alone. By using different injection fluids, veins and arteries may be shown by a gradation of tone. Mr. Orrin also hopes to be able to demonstrate nerves and lymphatics by this method. The plates which accompany the paper support the claims made, the minute ramifications of vessels in the hand, heart, viscera, etc., being beautifully demonstrated.

IN a paper on "The Cassiterite Deposits of Tavoy" (Rec. Geol. Surv. India, vol. xlix., p. 23, 1918), Mr. J. Coggin Brown points out that wolfram becomes separated from tin ore when washed out of a decaying lode on account of its rapid comminution and ultimate solution. As the author somewhat quaintly remarks, it "disappears long before its journey is ended." Much of the granite in the Tavoy district has been denuded to a level below that of the original lodes, the cassiterite being now represented only in the marginal contacts and the placer deposits. Another interesting mineral occurrence recently described in India is that of aquamarine in rich abundance in pegmatites in Kashmir (C. S. Middlemiss, *ibid.*, p. 161).

No. 6 of vol. iii. of the *American Mineralogist* (price 50 cents) is devoted to the memory of René-Just Haüy, and includes a valuable series of portraits, otherwise difficult to obtain. The articles deal with various aspects of the life and work of "the father of crystallography," and Prof. E. T. Wherry shows how Fedorov's "crystallo-chemistry" and his own extension of Fedorov's layer-theory into the field of optical properties are developments of Haüy's principle of rationality. Appropriately enough, Prof. A. Lacroix has recently given us a careful biography and appreciation of Haüy's contemporary, Déodat Dolomieu (*Revue Scientifique*, No. 2, 1919), in which interesting details are given of Dolomieu's imprisonment in Palermo after Bonaparte's Egyptian expedition, and of the efforts of scientific men for his release. Finally, he was included by name in the terms of a treaty of peace.

DR. H. A. TEMPANY, director of agriculture, Mauritius, communicates to the *Agricultural News* (February 22, 1919) an account of the Casuarina woods in Mauritius. Since 1807 the whole of the lands along the sea-coast to a minimum depth of 81 metres from high-water mark have been Government property, and the habit of planting them with trees, mainly *Casuarina equisetifolia*, to ensure a supply of fuel for the sugar industry, and also as shelter belts for inland cultivation, gradually became general. Since 1895 the leasing of these lands has been carefully regulated, and conditions for cutting and replanting strictly specified. About two-thirds of the area, representing 4440 acres, are now planted with Casuarina, and the remainder is under coconuts or mixed species of trees. The Casuarina woods have also been utilised for pasturage; a grass (*Stenotaphrum glabrum*) will thrive luxuriantly in the shade of the trees, growing right up to the base of the trunks. Dr. Tempany states that, apart from their economic importance, these Casuarina plantations have great value from an æsthetic point of view, making the littoral of Mauritius the most charming that he has ever seen in any tropical country.

THE annual report of the Weather Bureau at Manila for 1916, with hourly meteorological observations, has only quite recently reached this country. The Philippines are said to have been extraordinarily free from typhoons, although the weather map of the Far East shows that the number of typhoons was not much different from the average. Wireless weather messages are received from the vessels of the Asiatic Fleet at sea, and they are said to be of the greatest value in forecasting the weather. The closest co-operation exists between the Weather Bureau and the aviation officers. During the year the seismograph at Manila registered 395 disturbances; of these only 75 originated within 100 kilometres of the observatory. At Batuan there were 1022 disturbances, which is the highest number of records from any station. The year 1916 was magnetically disturbed beyond the normal. Astronomical work was well maintained. Hourly readings of most meteorological elements are "read directly between the hours 6 a.m. and 7 p.m., while for the hours from 8 p.m. to 5 a.m. they are taken from self-registering apparatus." The metric system is followed throughout, as in former years, no cognisance being taken of the new units of measurement. There is an absence of rainfall and sunshine observations in the annual volume.

DURING the last three years a good deal of attention has been directed to the question of protecting the eyes of furnacemen from the injurious effects of the strong light from the furnaces. The United States Bureau of Standards has found it necessary to issue a third edition of its Technological Paper No. 93, first issued in November, 1917, on the properties of the various glasses now available. The paper contains curves showing the transmitting properties of a large number of glasses, and the following general conclusions are drawn:—For protection from ultra-violet light, black, amber, green, greenish-yellow, and red glasses are efficient. Against the infra-red rays, deep black, yellowish-green, sage-green, bluish-green, and gold-plated glasses are best.

IN a paper presented at the meeting of the physics and chemistry section of the Franklin Institute of Philadelphia in January last, and reproduced in the March and April issues of the Journal of the institute, Mr. Luckiesh gives the results of the work which has been done at the research laboratory of the General Electric Co. on the reduction of the visibility of aero-

planes. Visibility from above when an aeroplane is seen against the ground is best reduced by using on the top of the wings a very dark shade of green for the high lights, and a bluish-black for the shadows. The surfaces when finished should reflect between 4 per cent. and 5 per cent. of the incident light. Visibility from below in the daytime is best reduced by the use of translucent fabrics and dopes. By a suitable blue tint an aeroplane can be rendered almost invisible against a clear sky. Visibility at night is best reduced by painting the aeroplane a matt black.

The Cambridge Scientific Instrument Co. has issued two lists of thermometers suitable for industrial use. List No. 114 deals with glass thermometers for steam plant, the chemical trade, jam- and sugar-boiling, bakeries, breweries, cold stores, and the metal industries. The instruments are well protected, and range from $-40°$ to $540°$ C. List No. 195 deals with distance thermometers required when the temperatures at a number of distant points are to be observed or recorded at some central office. They are of the resistance type, and for observation purposes are connected by plug switches to a current indicator in series with a small storage cell. The current is rendered independent of the change of electromotive force of the cell by the aid of a test-switch. For recording the temperatures continuously a thread-recorder is used. With both an indicator and a recorder installed any thermometer may be connected to the recorder and give a continuous record, while the other thermometers can, as desired, be connected to the indicator. In both lists full details as to construction and use of the instruments are given.

An article in *Engineering* for May 30 makes reference to the Still combined internal-combustion and steam engine which formed the subject of a paper read before the Royal Society of Arts on May 26 by Capt. F. E. D. Acland. This engine is an internal-combustion engine, the cylinder of which is jacketed with hot water at constant temperature. Heat abstracted from the combustion cylinder is employed in converting the jacket-water into steam. The jacket is connected to the water-space of a steam boiler, and this water, on its journey to the jacket, passes through a tubular heater, through which the exhaust gases pass. The steam and water leaving the jacket are led to the steam space of the same boiler. The exhaust gases on leaving the tubular heater are taken through a second heater, through which the feed-water is drawn. The steam from the boiler is used in a steam cylinder which forms the underside of the combustion cylinder. There is but one cylinder, the upper part of which is an internal-combustion cylinder, and the lower part a steam cylinder. The down stroke is an internal-combustion stroke, and the up stroke is a steam stroke. Remarkable economies are claimed. Thus a Still-Diesel engine with compounded steam side had a consumption of 0·302 lb. of Admiralty shale oil per brake-horse-power over one hour's run. Full test figures were not given in Capt. Acland's paper, which is somewhat unfortunate in view of the important features of the new engine. It is to be hoped that a complete record of engine dimensions and tests will be published in the immediate future.

The special catalogues of Messrs. H. Sotheran and Co., 140 Strand, W.C.2, are always of interest and value, and the latest one (No. 772), entitled "Bibliotheca Viatica," is no exception. It gives particulars of upwards of nine hundred second-hand works dealing with, among other subjects, maps and atlases, road, railway, and hydraulic engineering. There is also a section, necessarily not very lengthy, on books relating to ballooning and aeronautics. The catalogue contains many items likely to appeal to readers of Nature, and should be seen by them.

Messrs. Longmans and Co. have nearly ready for publication Dr. J. F. Spencer's "The Metals of the Rare Earths" and a new edition of J. F. Colyer's "Dental Surgery and Pathology." They have also in the press Dr. R. A. Houstoun's "The Elements of Physics" and E. W. Blocksidge's "Ships' Boats: Their Qualities, Construction, Equipment, and Launching Appliances." *Messrs. G. G. Harrap and Co., Ltd.*, are issuing "General Science," by L. Elhuff, and *Messrs. Baillière, Tindall, and Cox* promise a "Popular Chemical Dictionary," by C. T. Kingzett.

Messrs. W. Heffer and Sons, Ltd., Cambridge, offer in their latest catalogue (No. 179) some four hundred books in new condition at substantial reductions on pre-war prices. The list is a general one, but there is a section devoted to books on natural history and other branches of science. In it we notice Prof. J. C. Adams's "Scientific Papers," 2 vols.; J. G. Hagen's "Atlas Stellarum Variabilium," six series; R. Braithwaite's "The British Moss-Flora," 3 vols.; W. C. Hewitson's "Exotic Butterflies," 5 vols.; H. Seebohm's "The Turdidæ, or Family of Thrushes," edited and completed by R. Bowdler Sharpe, 2 vols.; Wilson and Evans's "Aves Hawaiienses," in parts; and sets of "Biologia Centrali-Americana." The catalogue is sent free upon application.

OUR ASTRONOMICAL COLUMN.

An Interesting Meteor.—A small fireball was seen on May 19, 11.39 G.M.T., by Mr. Denning at Bristol and by Mr. Mattey at Woolwich; it moved very slowly from a radiant point hitherto unknown in May at about $68°+63°$. The Rev. M. Davidson has computed the real path, and finds that the height of the object was from 53 to 32 miles, the length of the observed luminous course 46 miles, and the velocity about 10 miles per second. The theoretical velocity is 14 miles per second, but atmospheric resistance must have greatly impeded the flight of the meteor. Mr. Mattey saw several other meteors during the latter half of May from the same radiant in Camelopardalus.

The Sun-spot Maximum.—In reporting on the sun-spots observed in the year 1918 Mr. Evershed, director of the Solar Physics Observatory, Kodaikánal, remarks that the maximum spot activity of the present cycle took place during the second half of 1917 for both hemispheres. This judgment may be accepted as correct, for though some hesitation has been felt in accepting this early date lest a secondary maximum should occur after a temporary decline, as has happened in previous cycles, these circumstances do not seem likely to occur. The date of the previous maximum has been placed in the early part of the year 1906, though the sun-spot activity of that year was inferior to that of 1905 and of 1907. Adopting these estimates as correct, the length of the period just ended is slightly above the average.

The Mount Wilson Observatory.—The stellar observations in the programme of the institution of which Prof. Hale is director, hitherto called the Mount Wilson Solar Observatory, California, or sometimes the Solar Observatory of the Carnegie Institution of Washington, have lately been increasing in importance. In view of this fact, and of the practical completion of the 100-in. reflector, which will add greatly to the range and number of night observations, it is proposed that the word "Solar" shall be dropped, and

that in future the designation "Mount Wilson Observatory" will be employed, as it is in Prof. Hale's report for 1918.

SUN-SPOTS AS ELECTRIC VORTICES.—Adopting the hypothesis that sun-spots are vortices in which electrified particles produced by ionisation in the solar atmosphere are whirled at high velocity and thereby give rise to magnetic fields, Prof. Hale has built up a research in which he determines the polarity of the field or direction of rotation of the vortex by observation of the Zeeman effect in the spectrum of the spot. In the early stages of this research, before the minimum of 1912, it was found that in the case of groups which consist mainly of two large spots these components were of opposite polarity, and that, in general, the polarities of the leading spots, and consequently of the following spots, were of opposite sign in the northern and southern hemispheres of the sun. After the minimum the surprising fact emerged that the polarities were reversed in both hemispheres—that is to say, the preceding spots of northern bi-polar groups which before the minimum were of the same polarity as the north magnetic pole of the earth were of the opposite polarity after the minimum. This state of things endured, and the interesting question arose whether a similar reversal would occur at or near the sun-spot maximum, but in Prof. Hale's report for 1918 it is stated that no general change of polarity has been observed since the maximum, which occurred in the latter half of 1917.

SCIENCE AND WAR.

ON Thursday, June 5, in the Senate House of the University of Cambridge, before a distinguished audience, Lord Moulton delivered the Rede lecture on science and war. After pointing out generally how the advances in scientific knowledge had revolutionised the methods of warfare since the last great European conflict in 1870–71, the lecturer dealt specifically with some of the more conspicuous examples of what had been achieved during the present war through the application of science to military problems. Beginning with explosives, he recalled the discovery some seventy years ago of guncotton and nitroglycerine, and showed how it led to the production of the smokeless powders that have revolutionised tactics both by land and sea. At first it was found impossible to use guncotton and nitroglycerine for anything but blasting or like destructive purposes until the discovery was made that, by the aid of certain volatile solvents, the two substances could be incorporated so as to produce a material resembling gelatine, which could be formed into pieces of any shape or size. While these gelatinised powders burn with extreme rapidity, they are poor conductors of heat. Thus when the charge is fired all the pieces begin to burn on the surface, and the combustion spreads itself through each piece of the material more rapidly than the high temperature can pass inwards by conduction of heat. Hence the pieces always burn from the outside, and by making the amount of the surface large or small compared with the bulk the rate of burning of the powder can be controlled.

Besides providing a perfect propellant, science had also given the high explosives needed for shells. These are distinguished by the high rate of rise of the pressure which they produce on explosion. The rate at which the pressure comes on in a 6-in. gun is about 10,000 tons per square inch per second, so that it rises to the full pressure of 15 to 20 tons in something under the five-hundredth part of a second. In a good high explosive the rate of rise per second was several millions of tons per square inch, and the period was a fraction of a thousandth part of a second. Hence the shattering effect of these high explosives. High explosives show the remarkable peculiarity that there are two distinct ways in which they can explode. One gives rise to a comparatively mild explosion which opens out the shell, but does little more; the other is a fierce detonation by which the shell is rent to pieces. The cause of this is not understood, but it is undoubtedly connected with the intensity of the initial disturbance which sets the explosive off. By the commencement of the present war we had learnt how to detonate with fair, but not absolute, certainty the high explosives then used in the Service. But the prospect of the supply of toluene failing to equal the enormous demands of our shells necessitated a change of high explosive, and the one that was taken required special study before detonation could be ensured. It was achieved through the unremitting labours of those scientific workers who, little known to the public, have had to face and solve the innumerable problems that have presented themselves during the war. Through their labours we arrived at a degree of excellence which reduced the proportion of shells which failed to detonate from all causes to so small a figure that it was, the lecturer believed, little more than one-fifth of that of our adversaries.

Lord Moulton then referred to the changes in artillery which the new explosives had brought about, mentioning our howitzers, which, at ranges such as eight to fifteen miles, could be relied on to fire shot after shot with a variation of a few yards only, and also making some interesting statements with regard to the long-range gun which the Germans used to bombard Paris. Amongst other things, he pointed out that the distance passed over by the projectile was so great that if the Germans had taken the trouble to aim at any particular building they must have allowed nearly half a mile for the fact that during the flight the rotation of the earth would to that extent carry the target further towards the east than it would carry the gun.

The most hateful chapter of the work of science in the war was the introduction of chemical warfare. The first gas attack was on April 22, 1915, and it was not until the following September that we were able in any way to retaliate. But our immediate reply was one that did honour to science. Due to the splendid work of the late Col. Harrison, a system of defence by gas-masks was established, in which we were for the greater part of the war far ahead of our adversaries, who succeeded in coming up to us only by learning and copying our methods.

Finally, the lecturer paid an eloquent tribute to the assistance rendered by science in the war in dealing with disease and wounds, with particular reference to the success which had attended the use of anti-tetanus serum, to the reduction of the rate of mortality in spotted fever to one-tenth of its former value, and to the complete elucidation of the mode of transmission of bilharziasis, a disease with which we were faced through the presence of large contingents of our troops in Lower Egypt. Lord Moulton's conclusion was that one overmastering lesson was to be derived from the contemplation of all that science had done in the war. She had made mankind too formidable a being to be permitted to have recourse to it. The uncontrolled indulgence on the part either of a nation or of an individual in the exercise of the power that science had placed within reach was too directly fatal to civilisation itself. It was easy to criticise the League of Nations and to point out the difficulties, and even impossibilities, with which it was faced, but we should never forget that some combined action of that type was an imperative necessity.

INDIAN SURVEY REPORT.

THE records of the Survey of India, vol. xi. (supplementary to the General Report, 1916–17), including the Annual Report of Parties and Offices, 1916–17, contain little that can be considered as matter of wide scientific interest or of great importance from either the geodetic or the geographical point of view. It is the usual summary of excellent work completed by the officers of the Survey of India Department, amply illustrated by special charts and tables of the results of scientific observations, which occupy a very large space in the report.

The department was necessarily short-handed owing to the absence on active service of many of its officers, and one or two of those special branches of research which have been systematically undertaken by the scientific experts of the Trigonometrical Survey have been temporarily suspended. Thus there are no fresh records of pendulum, or of latitude, observations such as have lately added so much valuable evidence to investigations dealing with the force of gravity; but there is a useful summary of the conditions under which some of the early pendulum observations were taken (notably those of Col. Basevi at Moré), which will serve as a guide to future investigators. The conclusion expressed by Col. Lenox Conyngham is to the effect that "the Moré observations are too uncertain for any argument to be based on them"—a conclusion which was more or less anticipated by Prof. Borrass, of the Prussian Geodetic Institute, and Mr. R. D. Oldham. It is a question of instrumental stability, not of personal accuracy in observation.

No new base line was measured during the year under review. There are, on the other hand, very complete tables of the results of the Magnetic Survey under Mr. Bond, a subject which has lately derived increasing public interest from the investigations of Mr. E. A. Reeves, of the Royal Geographical Society's staff, who has published the results of a new method of reduction of the dip angle to a common line of reference provided by the axis of the earth's rotation, and proved that curves of equal dip are approximately coincident with parallels of latitude. Mr. Reeves's views on this subject, fully illustrated, will be found in the March issue of the Journal of the society.

First-class triangulation appears to have been confined to the Madura Series, and some useful hints may be derived from the report as to methods of dealing with those flat, jungle-covered regions of which there is such a superabundance in the untriangulated spaces of the earth. This is really a far more important matter for investigation and discussion than it may appear to be at first sight. The topographical section of the report confines itself to the details of the most practical side of surveying. There is nothing of an exploratory nature about them. The work of transfrontier reconnaissance is in abeyance, and nothing is said about Mesopotamia.

An illustrated section of the report, which deals with the representation of "relief" in maps by means of a series of coloured plates, would perhaps meet with a certain amount of criticism if it were brought a little more into public view by inclusion in some well-known periodical. One great fault of the Indian Survey reports is that the popular side of them is not sufficiently within reach of the public. Map reproduction generally, and the best way of representing relief, are, in these days of a greatly increased interest in geography, subjects on which there are many opinions and wide divergences of view. The methods adopted by the Indian Survey are admittedly not entirely satisfactory, and the difficulties in the way of making them satisfactory are fairly well explained in this report. It would certainly be useful if such an important map-producing department as that of the Survey of India could inaugurate a discussion (especially on the subject of a colour scheme) in which the public which uses its maps could express a free opinion. T. H. H.

SUB-ANTARCTIC WHALES AND WHALING.[1]

THE history of whaling in northern waters, and of the hunting of sperm whales in warmer seas, has often been written, and some of the principal facts relating to these subjects are matters of common knowledge. There is reason to believe that the existence of a whaling industry, which was inaugurated just outside the South Polar circle after the commencement of the present century, is by no means generally known. Although Capt. Cook, Sir James Ross, and others had many years before reported the presence of whales in those latitudes, no practical advantage was taken of the information until fourteen years ago; and since that date the industry has eclipsed in importance all that had been done previously, even when the Greenland whale "fishery" was at its height.

In 1892 Capt. C. A. Larsen left Norway for the Far South, which he reached in the October of that year. No whaling was done, and an expedition to the same regions, fitted out by Capt. Svend Foyn in the next year, was also unproductive of whales, mainly for the reason that it had been intended to hunt right whales and sperm whales. The Norwegian captains brought home, however, a very vivid impression of the enormous number of whales frequenting sub-Antarctic waters; and the fact that they at first made no further ventures was due to the profitable nature of the whaling in the neighbourhood of the Norwegian coasts. Dr. W. S. Bruce had simultaneously (1892) accompanied four vessels of the Dundee whaling fleet to the Antarctic, and had been similarly impressed with the abundance of whales in these waters. A meeting was shortly afterwards held in the rooms of the Royal Scottish Geographical Society at Edinburgh to advocate the use of the modern Norwegian methods of whaling in the South; but the proposal was not carried, and no practical steps were taken.

Capt. Larsen afterwards became the commander of the *Antarctic*, the exploring vessel of Dr. O. Nordenskjöld's Swedish South Polar Expedition, 1901–3. The *Antarctic* was wrecked; and Capt. Larsen, on his return journey, found himself at Buenos Aires, where in 1904 he founded the Compania Argentina de Pesca, the first whaling company which undertook operations in the Far South. This company commenced work at South Georgia in 1905, while the South Shetland Islands were visited with the same object in 1906, and the South Orkney Islands in 1911. The operations have proved so successful that there are now numerous companies whaling at South Georgia and the South Shetlands, a large proportion being Norwegian. While the most successful whalers in the Greenland industry from the seventeenth to the nineteenth centuries were the British and the Dutch, the Norwegians have almost a monopoly of the art at the present time, and nearly all the skilled workers are of that nationality.

The older whalers hunted with hand-harpoons from small boats, provided with sails and oars, which were

[1] From a discourse delivered at the Royal Institution on Friday, May 16, by Dr. S. F. Harmer, F.R.S. (Published by permission of the Trustees of the British Museum.)

launched from the parent ship on sighting a whale. The objects of their chase were principally the Greenland whale, the Atlantic right whale, and the sperm whale; and they were unable to attack and capture the larger and swifter rorquals.

About 1865 the Norwegian whaling captain Svend Foyn invented the modern whaling-gun, which was fitted with an explosive tip and a barbed harpoon carrying a strong rope. The explosion was regulated so as to occur immediately after the harpoon hit the whale, which is sometimes killed at once, and in any case is severely injured by a successful shot. The gun is carried in the bow of a steam-whaler, which chases the animal until a favourable opportunity for shooting occurs. These methods have revolutionised whaling, and there is now no whale which is too large to be captured.

In the prosperous days of the Greenland whale "fishery," 1437 whales were caught by seventy-six ships in 1814—an average of not quite twenty whales to each vessel—and this is mentioned by Scoresby (1820) as a specially good year. At the present day the number of whales caught by a single vessel during the whaling season of six months may rise to more than three hundred; and the total number caught off South Georgia and the South Shetlands together has exceeded 10,000 in one year. Bearing in mind the universal history of whaling in the past—a period of prosperity succeeded by a rapid decline and a final abandonment of the industry—the question arises whether there is not a serious danger that sub-Antarctic whaling will have a similar experience.

The question of the disappearance of the whales is not merely a sentimental one, though zoologists would naturally view their extermination with deep concern on scientific grounds. The plea for their preservation may be strengthened, however, by emphasising the fact that they are of the highest economic importance. The baleen or whalebone of the right whales is a material of much practical utility for many purposes; but its importance is almost negligible compared with that of the oil which is derived from the blubber and other parts of whales. Whale-oil can be readily transformed into soap and glycerine, while it is possible to prepare from it a fat which is perfectly inodorous and is utilised in the manufacture of margarine. During the war it has been of vital importance. Enormous quantities of glycerine derived from it have been used for the manufacture of explosives, and it has been scarcely less important in its relation to the food supply. If whale-oil had not been obtainable, the glycerine which was essential for our national security must have been derived from other animal fats or from vegetable oils, and the shortage of fat required as food would have been very serious. After the oil has been extracted on the whaling grounds, the remainder of the carcass may be dried and ground down into "guano," which is valuable as a fertiliser for crops, and is also utilised for the preparation of cattle-foods. It is not always possible to carry out this part of the process, and an enormous waste of valuable material may result from this omission. Since it is well known that the flesh of Cetacea is fit for human food, it is by no means impossible that a part of the enormous quantity of meat which might be obtained from them may be so utilised in the future.

Although a few right whales and sperm whales are captured by the sub-Antarctic whalers, who occasionally kill some of the smaller Cetacea as well, the industry in these waters is almost entirely confined to three species of the larger whales. Of these the humpback rarely exceeds 55 ft. in length, the fin whale is not much more than 85 ft., while the blue whale, probably the largest animal that has ever existed, is sometimes more than 100 ft. long. In the first few years of sub-Antarctic whaling the humpback constituted nearly the whole catch, even more than 96 per cent. in 1910–11, when 5299 individuals of this species were captured off South Georgia in the six months of the principal whaling season. In 1912–13 the number of humpbacks caught in the same locality, in the corresponding six months, fell to 2251 (about 53 per cent. of the total catch), and in 1913–14 it was reduced to 474 (about 18 per cent.). This diminution, which has persisted to the present time, has been due largely to a reduction of the number of humpbacks frequenting South Georgia; but it has been partly caused by an increase in the size of the whaling vessels and of the strength of the tackle employed, enabling the whalers to hunt the larger kinds, which naturally yield more oil and other products than the comparatively small humpback. The whaling industry thus depends at present almost entirely on the fin whale and the blue whale. It is noteworthy that the fin whale, of intermediate size, first rose to prominence on the decline of the humpback; but the gigantic blue whale has now surpassed it, and has become the favourite object of the whalers' pursuit. There is at present no certain evidence of the reduction in numbers of fin whales and blue whales.

In explaining the reduced number of humpbacks frequenting the whaling grounds, the whalers rely on the hypothesis that individuals of this species are of a timid nature, and are readily frightened away from a locality by pursuit. There is probably some truth in this view, but it is at least possible that the reduction is due to a diminution in number of the total stock of humpbacks. Whales are migratory animals, and their movements are almost certainly influenced by two causes: (1) the distribution of their food supply; (2) the position of their breeding grounds. The plankton organisms on which the whalebone whales subsist are present in vast quantities in polar waters during the summer, and the whales are accordingly found there at this period. Towards the end of the summer or the beginning of autumn most of them forsake high latitudes. The southern humpback executes extensive migrations northwards, along the coasts of the great southern continents, to the neighbourhood of the equator, and even beyond it. It is in these warmer waters that it is known to breed, and it afterwards proceeds southwards in the ensuing spring. One of the most alarming facts about this species is that it has been extensively hunted along the coasts of Africa, South America, and elsewhere. Although it is not possible to assert positively that the South Georgia humpbacks are thus affected, there are strong reasons for believing that this is the case; and it would thus follow that this species is persecuted in sub-Antarctic waters during the summer, and further north during other parts of the year. Remembering that the old whalers reduced the Greenland whale almost to the point of extermination by the use of what may now be regarded as primitive methods, and that a similar fate has befallen the once-flourishing whaling industries of other localities, it thus appears that there are the most urgent reasons for seeking to afford some immediate measure of protection to this and other species of whales.

In devising methods for the protection of animals, the principle of saving them from being hunted during their breeding season has been found specially effective. It is very difficult to get complete information on this subject with regard to whales, but one of the ways in which a conclusion may be reached is the examination of fœtal records, a method which has already been adopted with some success by Guldberg and others. By the study of a relatively large mass of statistics which has been supplied to the British Museum (Natural History) by the whaling companies

operating off South Georgia, I have found it possible to arrive at certain definite results which amplify or correct those of previous observers. These are specially clear in the case of the fin whale, which has provided the largest number of records. It is found that in a given month there is a particular length of fœtus which has the greatest frequency; that in the next month a greater length is most common; and so on for several succeeding months, after which the whaling season comes practically to an end, and the number of records is inadequate to give a normal result. Although there are certain irregularities needing explanation in the graphs constructed from the statistics, the general result has been arrived at that, in each of the three species principally hunted at South Georgia, pairing takes place with greatest frequency at a certain period of the year, and that a normal curve of pairing can be drawn. This result gives, in the main, a satisfactory explanation of the statistical records. The season when pairing is at its height falls in each case outside the period when whaling is actively carried on in the Far South; and the important conclusion is reached that if the whales are to be protected during their breeding season, it must probably be done in regions of the world farther north than South Georgia. The validity of the southern figures, which have, no doubt, been roughly recorded by the whalers, has been confirmed by obtaining corresponding results from the examination of the statistical fœtal records of northern whales.

It can scarcely be doubted that protective measures of some kind are urgently necessary now, or will at least become so in the near future; although it is by no means certain what form they should take. The British Government is, in some respects, in a specially favourable position with regard to this matter, since all the important whaling grounds of the sub-Antarctic region belong to the Dependencies of the Falkland Islands and lie in its jurisdiction. It is satisfactory to be able to conclude with the statement that the Government is fully alive to the necessity of taking steps before it is too late, and that an Inter-Departmental Committee is at present engaged, under the auspices of the Colonial Office, in framing a scheme for an expedition which is to investigate the whaling problem on the spot, with the view of obtaining information on which legislation may be based.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The governing body of Emmanuel College offers two exhibitions, each of the value of 50*l*. and tenable for two years, to research students commencing residence at the college in October, 1919. The exhibitions will be awarded at the beginning of October, and applications should be sent so as to reach the Master of Emmanuel (the Master's Lodge, Emmanuel College, Cambridge, England) not later than September 24.

LONDON.—A war memorial scheme for University College, University College Hospital and Medical School has now been settled, and an appeal for a sum of 30,000*l*. is being issued to all old students of the colleges whose addresses are known. The complete scheme as settled by a representative and influential committee, under the patronage of the Earl of Rosebery, Chancellor of the University of London, includes the following features:—A war memorial album, containing the records of the academic and Service careers of the 268 men who have fallen; memorial tablets recording their names; scholarships for the sons and daughters of the fallen; a great hall for the use of the college and medical school; and the endowment of University College Hall, Ealing. The hon. treasurer is Capt. Wedgwood Benn, who is a fellow of the college; donations sent to him at University College will be gratefully acknowledged.

OXFORD.—On June 10 the question of an application for a Government grant came before Convocation, and by 126 votes to 88 it was decided to authorise the Vice-Chancellor to apply for a Government grant or grants, and to accept the same on behalf of the University on condition that the University should co-operate with the Government in an inquiry to be made into its whole resources and the use which is being made of them.

It appears to be generally allowed throughout the University that a large accession of funds is necessary for the efficient working of the scientific departments under present-day conditions; nor does there seem to be any widespread objection to such an inquiry as is proposed. In several quarters, however, distrust is felt as to the possible effect of control by the Board of Education, which appears to be an unavoidable consequence of the acceptance of a grant of public money. The independence hitherto enjoyed by the University in educational and administrative matters is believed by a minority to be at stake. The view, however, has prevailed that these apprehensions are groundless, or at least are not sufficient to outweigh the positive advantages to be gained by approaching the Government, and the division just taken in Convocation shows that the University is prepared to face the risk.

MR. S. O. RAWLING has been appointed lecturer in chemistry at Robert Gordon's Technical College, Aberdeen.

THE resignation of Prof. W. M. Gardner of the principalship of the Municipal Technical College, Bradford, is announced.

IT is announced that the Most Rev. John Henry Bernard, D.D., Archbishop of Dublin, has been appointed Provost of Trinity College, Dublin, by the Crown in succession to the late Sir J. P. Mahaffy.

WE have received from Mr. H. Valentine Davis, "Noddfa," Wistaston, Crewe, a programme of a course of field-work in Snowdonia for the outdoor study of geography, botany, and geology, which he has arranged to conduct between July 30 and August 13 at Llanberis. Mr. Davis is prepared to receive applications from teachers and others who desire to attend the course.

THE executive committee of the Ramsay Memorial Fund reported to a meeting of subscribers on June 5 that a sum of 43,000*l*. is in hand and 70,000*l*. in view, so that the 100,000*l*. aimed at is within realisation. It was resolved that:—(1) A sum of 25,000*l*. be definitely allotted to the Senate of the University of London towards the provision of a laboratory of chemical engineering at University College, London, on the site proposed in close proximity to the existing engineering buildings. (2) The executive committee be empowered to employ the balance of the fund already subscribed, and all future donations to be received, to the foundation of Ramsay memorial fellowships to the number of three or to such smaller number as they may deem expedient until the fund is sufficient for founding fellowships. (3) If and when the amount of the fund exceeds the sum required for giving effect to resolutions (1) and (2), the division of such further sum between the augmentation of the sum allotted for the chemical engineering laboratory and the augmentation of the number of available fellowships be referred to the executive committee for decision.

THE University of Liverpool has recently established a Tidal Institute for the purpose of research into tidal questions, and to constitute a bureau of information on matters connected with tides. The work contemplated at present is mainly mathematical and computative, though doubtless this will lead in time to special schemes of observation, perhaps in co-operation with other bodies. The necessary funds have been provided by Sir Alfred Booth and Mr. Charles Booth, chairmen respectively of the Cunard and Booth steamship companies, while Dr. J. Proudman will be the honorary director of the institute. It is very satisfactory that this country should again have a centre of tidal learning and research at one of its universities, to continue, under a new form, some of the services rendered to the science by Sir George Darwin. It is not possible to judge as yet whether or not this makes unnecessary the inclusion of tidal matters in the larger scheme for a geodetic institute now being discussed, but in any case, through the wider range of activity on the part of the latter and the intensive theoretical studies of the Liverpool institute, each body may be expected to be advantageous to the success of the other.

THE almost universally conceded necessity for attracting well-qualified teachers into the profession by offering really adequate salaries and improved prospects does not appear to be appreciated by some education authorities. Recent advertisements in the *Newcastle Evening Chronicle* by a local education authority show that 170*l*. to 200*l*. per annum is thought to be an adequate and attractive salary for a well-qualified science master who is required for advanced course work, and that a "slinger" for loading machinery parts and engines can command a wage of 5*l*. per week (260*l*. per annum). The comparison does not accentuate the value of a good education, nor will it create enthusiasm in the minds of possible entrants to the profession. We may add that in many rural districts, especially in Wales, it is the exception to find secondary-school teachers, even with experience, enjoying a salary of more than 160*l*. per annum. The lamentable inadequacy of salaries has reacted upon the supply of teachers, which does not now approach the normal demand, and this renders all the more difficult the problems of staffing the new continuation schools provided for in the recent Education Bill, and of diminishing the size of classes in the secondary schools to the advantage of the pupils. We cannot urge too strongly that the provision of a really efficient system of national education depends, to a great extent, upon the payment of adequate salaries to the teaching staff, and that the question as to whether rates or taxes are to provide the additional cost should not influence the educational facilities offered to the youth of the country.

AT a meeting of the Yorkshire Natural Science Association at Sheffield on Saturday, May 24, Prof. Ripper, Vice-Chancellor of the University, speaking on "Science and Reconstruction," said that the task of those who wished to promote the extended use of science and scientific method in industry was to urge the importance of using them in all those industries which as yet were untouched by the spirit of modern scientific progress. Science could help in two ways: first, by the gift of new knowledge, built up by the scientific worker with no regard to its industrial value; and, secondly, by the application of scientific method and principles to problems of industry. No manufacture could afford to dispense with the services of the well-trained man of science, who was required wisely to direct the activities of the two partners, capital and labour. Prof. Ripper welcomed the formation of the Privy Council Committee for the purpose of establishing research associations in connection with national industries. The light trades and the glass industry of Sheffield were taking steps towards reorganisation and enlisting the help of the scientific expert. For the most part, the work of training these men of science would devolve upon the universities, and to that end their resources would have to be augmented. The staff and equipment were at present fully occupied in the teaching of the undergraduate, and better provision must be made for the advanced student. Governments were the servants of public opinion, and until public opinion was fully awake to its duty to the universities and recognised the need for an adequate supply of trained persons, the progress of industry would be severely handicapped.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, May 9.—Prof. C. H. Lees, president, in the chair.—A. E. **Bawtree**: A new colour transparency process for illustrating scientific lectures. The image is produced in a thin colloid film upon bare glass. Considerable experimenting led to the selection of a range of dyes and mordants by which practically any shade of the most brilliant colouring could be obtained. By suitable insulating films, images in any number of colours can be superimposed and accurately registered with one another. Thus diagrammatic slides can be prepared in various colours. The passage of a beam of white light through a prism can be shown spreading out into bands of colour, instead of merely initialled lines. Coloured mosaics can be placed in a diffusing lantern to show the preparation of additive colours, *e.g.* red and green producing yellow more convincingly and brilliantly than with the Maxwell disc.—F. J. W. **Whipple**: Absolute scales of pressure and temperature. The paper urges the general use of the new scales of pressure and temperature which have been adopted by meteorologists. In the pressure-scale the fundamental unit is the bar, the pressure due to a million dynes per square centimetre. The practical unit is the millibar. The temperature-scale is that known as the pseudo-absolute scale, obtained by adding 273 to the Centigrade scale. The author, however, considers that it would be advantageous to use the "integral freezing point" scale, in which the interval between absolute zero and the freezing point of water is divided into 273° exactly.—Dr. A. O. **Rankine**: The transmission of speech by light. Light from a point source is collected by a lens of about a metre focus, and an image formed on a small concave mirror, which is attached to the diaphragm of a gramophone recorder. The light diverges and passes through a second similar lens, which projects it to the distant station. Two similar grids are mounted, one in front of each lens. An image of the first grid is superposed on the second by reflection in the concave mirror. When the latter oscillates under the vibrations of speech, the dark spaces of the image move over the openings of the second grid, thus producing fluctuations of the intensity of the beam. The light is received by a collecting lens and focussed on a selenium cell in circuit with a battery and telephone receiver.

Geological Society, May 21.—Mr. G. W. Lamplugh, president, in the chair.—C. I. **Gardiner**: The Silurian rocks of May Hill. With an appendix by Dr. F. R. Cowper Reed. The district of May Hill comprises a small area of ashy grits, which Dr. Callaway in 1900 considered to be of pre-Cambrian age. The evidence now available does not seem to warrant any definite opinion as regards the age of these beds. Dr. Reed

describes a new species of Lichas from the Wenlock Limestone and a new variety of *Calymene papillata.*—Dr. A. **Gilligan**: The petrography of the Millstone Grit series of Yorkshire. Since the pioneer work of Sorby on this subject, published in 1859, the clastic deposits of the Carboniferous system have been unaccountably neglected by petrologists. The author has followed the usual methods of investigation, and collected a large number of pebbles and specimens from widely separated areas, which have been examined microscopically. Numerous separations of the heavy minerals have also been made from all types of rock, varying from coarse conglomerates to shales, which occur in the series. In Yorkshire the Millstone Grit forms the surface of 840 square miles; while, if that which lies beneath the newer rocks and that represented by outliers on the Pennine Fells were taken into account, it must have extended over at least 2000 square miles. If 1000 ft. be taken as its average thickness, the Yorkshire Millstone Grit would represent a volume of 400 cubic miles, the equivalent of a range of mountains 800 miles long, 1 mile high, and 1 mile wide at the base. The author shows that the most probable source of the material lay in a land-mass of continental extent, of which Scandinavia and the North of Scotland represent the remaining fragments. In these areas alone can the mineralogical demands of the Millstone Grit be satisfied, and the author institutes a comparison between the Torridon Sandstone and the Millstone Grit, which shows that their similarity of constitution is altogether too great to be merely fortuitous. He infers that, despite their disparity in age, they had a common source in that northern continent.

Society of Glass Technology, May 21.—Dr. M. W. Travers in the chair.—Dr. W. **Rosenhain**: Some phenomena of pot attack. Research was begun on the improvement of methods for the production of optical glass. The first step was to find a material to arrest the attack of molten glass, and to endeavour, if possible, to discover a container entirely insoluble in glass at high temperatures. A study of glass attack upon clay was begun, and the process by which glass attacks clay investigated. These processes, owing to the novel methods used, could be carefully controlled under standardised conditions. Small pots made of china clay cast by a special method were used in the research. The furnace was an electrical one, so constructed that temperature and atmosphere could be kept constant. The pot attack of several glasses known to be very violent in their action upon clay was studied. The amount of pot attack was measured exactly under various time and temperature conditions. The result showed that the attack was mainly on the bottom of the pot, and that holes were drilled in a rough, circular form. In many cases it was shown that the amount of attack was proportional to the depth of the clay beneath the glass surface. The explanation of the results was somewhat difficult to find, but a study of the solution of solids in liquids less viscous than glass led to the conclusion that the phenomenon was due to currents set up in the liquid by density changes. One of the portions of the research had been the microscopic examination of the glass and pot after attack. This portion of the work is still in progress. It had been proved conclusively that holes could be drilled in a pot without having actual defects in the pot to start with. Another very interesting feature recently developed was the application of X-rays to the examination of small pots.

Zoological Society, May 27.—Dr. A. Smith Woodward, vice-president, in the chair.—J. T. **Cunningham**: Result of a Mendelian experiment on fowls, including the production of a pile breed.—Miss Kathleen F. **Lander**: Some points in the anatomy of the Takin (*Budorcas taxicolor whitei*).—E. Phelps **Allis**: Certain features of the otic region of the chondrocranium of Lepidosteus, and comparison with other fishes and higher Vertebrata.

Aristotelian Society, June 2.—Lord Haldane in the chair.—Dean **Inge**: Platonism and human immortality. The Platonic doctrine of immortality rests on the *independence* of the spiritual world. The spiritual world is not a world of unrealised ideals over against a real world of unspiritual fact. It is, on the contrary, the real world, of which we have a true, though very incomplete, knowledge, over against a world of common experience which, as a complete whole, is not real, since it is compacted out of miscellaneous data, not all on the same level, by the help of the imagination. There is no world corresponding with the world of our common experience. Nature makes abstractions for us, deciding what range of vibrations we are to see and hear, what things we are to notice and remember. It is the substantiation and continuance of this makeshift construction that we are sometimes childish enough to desire. What is real in it is the thought of God transmuted into vital law. The operation of these forces we study mainly in transverse sections, since we have forgotten most of the past and are ignorant of the future. But since the soul is a citizen of the eternal world, we can, if we will, "be eternal in the midst of time," though our higher life is for most of us fitful, indistinct, and confused. It follows that salvation, for the Platonist, must be *deliverance* from a world of shadows and half-truths, *per tenebras in lucem*.

CAMBRIDGE.

Philosophical Society, May 19.—Mr. C. T. R. Wilson, president, in the chair.—F. W. **Aston**: The use of neon lamps in technical stroboscopic work. The standard method of calibrating and testing revolution indicators for aero-engines is by means of a stroboscopic disc or cylinder illuminated by flashes of a neon lamp. The latter is lit by a small induction coil interrupted exactly fifty times per second by a standard electrically driven tuning-fork. Neon tubes of the ordinary spectrum type give a flash of considerable duration, some thousandths of a second, and therefore are unsuitable. This flash when analysed by a rotating mirror is found to consist of a single practically instantaneous flash followed by a flame or arc. By means of a special form of lamp the whole of the energy of the discharge can be thrown into the first flash, the duration of which has so far defied measurement, and is certainly less than one ten-millionth of a second, making it ideal for stroboscopic work. By illuminating an engine running at full speed by means of such a lamp arranged to give 99 flashes per 100 revolutions of the crank-shaft, the engine will appear to rotate at one-hundredth its real speed, so that the most minute observations on its moving parts can be made. This method has also been extended to the examination of air-screws for strains when running at high speeds.—F. W. **Aston**: The distribution of intensity along positive-ray parabolas of atoms and molecules of hydrogen, and its possible explanation. This paper deals with the bright arcs or "beads" on the positive-ray parabolas of hydrogen which correspond with half the normal energy, and therefore cannot be due to multiple charges. Experiments seem to indicate that the discharge can be separated into two types. In the first or "atomic" type, which can be obtained practically pure under certain conditions, it seems possible that the whole discharge is carried up to the cathode by ions of atomic mass. The proposed explanation of the bright arc on the molecular

parabola seen in this type of discharge is that it is due to atomic rays colliding with and capturing slowly moving neutral atoms in the canal-ray tube, and so forming molecular rays of half-normal energy. The second or "molecular" type, which has only been obtained associated with the atomic, is characterised by a very bright patch on the molecular parabola corresponding with normal energy, and two fainter equal symmetrical positive and negative satellite patches on the atomic parabola apparently caused by some of the charged molecular rays being dissociated by collision with a neutralising electron into atoms of opposite charge each with half the normal energy.—C. T. R. **Wilson**: A micro-voltameter. Experiments were described with a mercury voltameter in which one electrode consists of a sphere of mercury deposited on the end of a fine platinum wire and measured by means of a microscope. Quantities of electricity varying from a few hundred electrostatic units to about one coulomb may be measured by it. The almost instantaneous change of size of the drop when a capacity of one-tenth of a microfarad, charged to one volt, is discharged through the instrument is easily observed. A magnet inserted in or removed from a coil connected to the terminals of the voltameter produces an easily measured effect. Experiments were also mentioned which suggest the possibility of its application in measurements of much smaller electrical quantities.—R. **Whiddington**: The self-oscillations of a thermionic valve. It has been found possible to produce oscillations of almost any frequency from a three-electrode vacuum valve without employing the usual capacity induction circuits. Thus a valve with two suitable batteries, one in the anode circuit, the other in the grid circuit, will produce quite powerful oscillations, the frequency of which will be determined by the value of the grid potential. The phenomenon can be explained by supposing that the oscillations are due to surges of mercury ions closing in on the filament from the grid with a frequency given by the approximate formula

$$n^2 = \frac{2e}{md^2} \cdot V,$$

where e/m is the usual charge to mass ratio, d is the radial distance filament to grid, and V is the positive-grid voltage. Experiments conducted so far indicate that the monatomic Hg ion with one live charge is mainly responsible.

DUBLIN.

Royal Dublin Society, May 27.—Prof. Carpenter in the chair.—Prof. W. E. **Adeney** and H. G. **Becker**: The determination of the rate of solution of atmospheric nitrogen and oxygen by water. Part ii. This paper gives further results obtained, using the method of experimenting described previously (Scientific Proceedings R.D.S., vol. xv., p. 385, 1918), *i.e.* passing a large cylindrical bubble of air up through a narrow column of de-aerated water repeatedly until saturation is reached, and measuring the loss in pressure after each ascent. An improved form of apparatus is described and used to determine the rates of solution of oxygen and nitrogen as pure gases between 2·5° C. and 35° C., and determinations of solubility within these limits are also given. It is shown that the rate of solution varies in accordance with the equation

$$\frac{dw}{dt} = \mathrm{SA}p - f\frac{\mathrm{A}}{\mathrm{V}}w,$$

the values of f being given for the above limits of temperature between which S is nearly constant. The final results are given in the form

$$w = (100 - w_1)\left[1 - e^{-f\frac{\mathrm{A}}{\mathrm{V}}t}\right],$$

which gives the amount of gas dissolved (in percentages of saturation) after any time t, the initial gas-content being equal to w_1.

EDINBURGH.

Royal Society, May 5.—Dr. John Horne, president, in the chair.—Prof. C. R. **Marshall**: (1) Some conditions influencing the reaction-velocity of sodium nitrate on blood. Serum and alkalis have a marked retarding, and acids an accelerating, influence on the action of sodium nitrite on blood. The investigation was made with a spectro-photometer, the part of the spectrum observed being λ 571–577. The rapidity of the reaction was affected by the concentration of the blood and of the sodium nitrite. In the case of serum, ferment action played no part. It was found that with minimal concentrations of sodium nitrite an induction period, frequently varying with the specimen of blood used, occurred, which was increased by the addition of serum or sodium hydroxide. The duration of the reactive period was less influenced. The amount of sodium hydroxide necessary to delay the reaction varied with the concentration of sodium nitrite. The reaction occurred in, although it was greatly delayed by, moderately strong alkaline solutions, which seems to show that the action is not due to the formation of nitrous acid. The mode of action of sodium nitrite is promised in a future communication. (2) The mode of action of metal sols. This was an attempt to determine the way in which metal sols acted therapeutically by investigating the action of an electrolyte-free silver colloidal solution on bacteria. The action could not be explained by Brownian movement, surface phenomena, electric charge, catalytic power, or the concentration of ions in the dispersal medium. It appeared to be associated with the amicrons which, it is suggested, are taken up by the bacilli and probably converted into a soluble product.—Prof. W. H. **Metzler**: Factors of circulants.—Capt. T. Bedford **Franklin**: The cooling of the soil at night. This is a preliminary account of the observations made during the past winter in an endeavour to forecast the occurrence and severity of frosts. A relation was first established between the rate of radiation of the soil at night and the relative humidity of the air. The observations then showed the connection between the loss of heat in the surface of the soil by radiation and the gain of heat in the surface by conduction from the lower and warmer underground layers, together with the latent heat liberated when the surface freezes. It is hoped that in the near future it may be possible, early in the afternoon, to forecast the probability and severity of a frost on the coming night by means of readings of the relative humidity and of the underground temperatures and conductivity of the soil with a set of electrical resistance thermometers.—J. **Marshall**: An analysis of an electron-transference hypothesis of chemical valency and combination. In this paper an analysis is made of the electron-transference hypothesis of chemical combination put forward by Kelvin in 1902 and by Sir J. J. Thomson in 1904. The methods employed and the assumptions made are similar to those formulated by H. A. Lorentz in his discussion of the molecular refractive index of mixtures and compounds (*vide* "Theory of Electrons"). Part i. of the paper contains a discussion of the value of the atomic refractive index in the case of atoms from which electrons have been transferred, ignoring the contribution to this value arising from fields of electrical force due to the vicinity of other atoms or groups of atoms. In part ii. the author endeavours to obtain a formula for the molecular refractive index which will allow for the contribution due to the electrical action between the atoms of the molecule. It

is found that the assumption which best agrees with experimental evidence is that the external action of the atom which is electro-positive is eqvivalent to a doublet and a positive charge both situated within the atom.—Prof. W. **Peddie**: The thermo-dynamics of unstable states. It was pointed out that, although the usual thermo-dynamical definition of absolute temperature applies in all practical cases, the second definition, recently indicated by Sir Joseph Larmor as formally satisfying Carnot's conditions, has an interesting theoretical application in the case of unstable states of the working substance.

PARIS.

Academy of Sciences, May 19.—M. Léon Guignard in the chair.—G. **Humbert**: The measure of classes of ternary positive quadratic forms of given determinant. —A. **Gautier**: The influence of fluorides on vegetation. Preliminary trials in garden-pots. Of twelve species cultivated under similar conditions, with and without addition of fluorides, seven showed increased growth in presence of fluorides, three were indifferent, and three gave lower yields.—C. **Guichard**: A mode of generation of isothermal surfaces with plane lines of curvature in a system.—M. **Tilho**: A scientific expedition of the Institute of France in Central Africa (Tibesti, Borku, Ennedi).—M. Edouard Goursat was elected a member of the section of geometry in succession to M. Emile Picard, elected permanent secretary.—G. **Julia**: Integral or meromorphic functions.—E. **Kogbetliantz**: The developments of Jacobi.—H. **Muraour**: The determination of temperatures reached in explosive reactions. Both the methods in use presuppose that the composition of the gases at the moment of explosion is known. The temperature determined varies according as the methane is assumed to exist at the moment of explosion or to be formed during the cooling. Experiments with a modified bomb are described, and these prove that the greater part, if not the whole, of the methane is formed during the cooling period.—M. H. **Robert**: A new laboratory form of fractionating column and the measurement of its efficiency. The lower part of the column, a diagram of which is given, is vacuum-jacketed, whilst a similar upper column is cooled externally by a controlled air-current; the thermometer is surrounded by a vapour-jacket. Examples of the remarkable efficiency of the column are given. Pure hexahydrotoluene was isolated from Borneo petrol; pentane, hexane, and heptane from American petrol; acetic anhydride from its mixture with acetic acid.—G. **Claude**: An important consequence of the commercial synthesis of ammonia. Ammonium chloride has been proved by Georges Ville to be capable of replacing ammonium sulphate as a manure, and carries a higher percentage of ammonia. If in the ammonia-soda process the sodium bicarbonate and ammonium chloride are collected separately, the latter is available as manure, the chlorine of the salt is utilised, and the consumption of sulphuric acid avoided.—P. **Lesage**: The stabilisation of characters in plants grown in presence of salt.—H. **Coupin**: The place where water is absorbed by the root. From experiments detailed the conclusion is drawn that the root absorbs water exclusively through its tip, and not through the root-hairs.—M. **Dalloni**: The Coal Measures on the coast of the province of Oran.—J. **Lévine**: Two hundred and twenty years of (meteorological) observations in Paris.—G. **Lusk**: The comparative calorimetry of the ingestion of meat, lactic acid, and alanine in the animal.—A. L. **Herrera**: The pseudo-organisms of calcium fluosilicates.—E. **Bourquelot** and M. **Bridel**: The biochemical synthesis of cellobiose with the aid of emulsin.—E. **Kohn-Abrest**: Apparatus for the rapid analysis of confined air and unhealthy atmospheres.

CAPE TOWN.

Royal Society of South Africa, April 16.—Dr. J. D. F. Gilchrist, president, in the chair.—J. R. **Sutton**: Some controversial notes on the diamond. The author discusses the spontaneous breaking of diamonds and reaffirms his previous conclusions on the subject. It is claimed that there is no fundamental difference of process between the spontaneous breaking of a pure colourless crystal containing an inclusion of foreign mineral and that of opaque or clouded diamond. The probable derivation of distorted diamonds (pseudo-cleavage) from groups and clusters is also considered. The hardness of the diamond is generally over-estimated.

CALCUTTA.

Asiatic Society of Bengal, May 7.—N. **Annandale** and H. G. **Carter**: Notes on the vegetation of Seistan. The paper is based primarily on a collection of plants made, mainly in desert country and in the Hamun-i-Helmand or lake basin of Seistan, in November and December, 1918. A list of these plants is given and an attempt made to estimate the more conspicuous characters of the vegetation of several different types of environment, viz. the stony desert, the alluvial plain, the banks of streams of saline water, and the Hamun. Among the more interesting points brought out are the correlation between conspicuous colours and poisonous qualities in the plants of the desert, the different effects of soluble salts on the growth of different grasses, and the production of stiff, bayonet-like leaves in the same group in halophytic conditions.

BOOKS RECEIVED.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College and Papers in Elementary Engineering for Naval Cadetships for the years 1909–18. Edited by R. M. Milne. (London: Macmillan and Co., Ltd., 1919.) 7*s.*

The Principles of Electric-Wave Telegraphy and Telephony. By Prof. J. A. Fleming. Fourth edition, revised. Pp. xvi+707+plates vii. (London: Longmans, Green, and Co., 1919.) 42*s.* net.

Mammalian Physiology: A Course of Practical Exercises. By Prof. C. S. Sherrington. Pp. xi+156+plates ix. (Oxford: At the Clarendon Press, 1919.) 12*s.* 6*d.* net.

Soils and Manures in New Zealand. By L. J. Wild. Pp. 134. (Auckland and London: Whitcombe and Tombs, Ltd., 1919.) 2*s.* 6*d.*

The America of To-day: Being Lectures Delivered at the Local Lectures Summer Meeting of the University of Cambridge, 1918. Edited by Dr. G. Lapsley. Pp. xxv+254. (Cambridge: At the University Press, 1919.) 12*s.* net.

The Evolution of the Dragon. By Prof. G. Elliot Smith. Pp. xx+234. (Manchester: At the University Press; London: Longmans, Green, and Co., 1919.) 10*s.* 6*d.* net.

The Chemists' Year-Book, 1918–19. Edited by F. W. Atack, assisted by L. Whinyates. Vol. i., pp. vi+422; vol. ii., pp. iv+423–1146. (London and Manchester: Sherratt and Hughes, 1919.) 15*s.* net two vols.

Studies in the Construction of Dams: Earthen and Masonry. Arranged on the Principle of Question and Answer for Engineering Students and Others. By Prof. E. R. Matthews. Pp. v+43. (London: Charles Griffin and Co., Ltd., 1919.) 4*s.* 6*d.* net.

National and International Right and Wrong: Two Essays. By Henry Sidgwick. With a preface by the Right Hon. Viscount Bryce. (Reprinted from

the author's "Practical Ethics.") Pp. 77. (London: G. Allen and Unwin, Ltd., 1919.) 1*s.* 6*d.* net.

La Sélection Humaine. By Prof. C. Richet. (Bibliothèque Scientifique Internationale.) Pp. iii+262. (Paris: Librairie Félix Alcan, 1919.) 6.60 francs.

Atlante di Geografia Fisica, Politica ed Economica. By Prof. A. Mori. Fasc. 1, maps 18. (Torino, etc.: Ditta G. B. Paravia E.C., n.d.)

Birdland's Little People: Twelve Nature Studies for Children. By Capt. O. G. Pike. Pp. 123. (London: The Religious Tract Society, 1919.) 4*s.* 6*d.* net.

Barbed-Wire Disease: A Psychological Study of the Prisoner of War. By Dr. A. L. Vischer. Translated from the German. Pp. 84. (London: John Bale, Sons, and Danielsson, Ltd., 1919.) 3*s.* 6*d.* net.

Practical Physiological Chemistry. By S. W. Cole. With an introduction by Prof. F. G. Hopkins. Fifth edition. Pp. xvi+401. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall, Ltd., 1919.) 15*s.* net.

Problems of National Education. By Twelve Scottish Educationists. Edited by John Clarke. Pp. xxvi+368. (London: Macmillan and Co., Ltd., 1919.) 12*s.* net.

British Ferns and How to Identify Them. By J. H. Crabtree. Pp. 64. (London: The Epworth Press: J. Alfred Sharpe, n.d.) 1*s.* 6*d.* net.

Commercial Forestry in Britain: Its Decline and Revival. By E. P. Stebbing. Pp. vi+186. (London: John Murray, 1919.) 6*s.* net.

A Gentle Cynic: Being a Translation of the Book of Koheleth, commonly known as Ecclesiastes, stripped of Later Additions; also its Origin, Growth, and Interpretation. By Prof. M. Jastrow, jun. Pp. 255. (Philadelphia and London: J. B. Lippincott Co., 1919.) 9*s.* net.

Air Navigation: Notes and Examples. By Instructor-Capt. S. F. Card. Pp. vi+140. (London: Edward Arnold, 1919.) 10*s.* 6*d.* net.

The Voyage of a Vice-Chancellor. Pp. ix+139. (Cambridge: At the University Press, 1919.) 6*s.* net.

Influenza: A Discussion Opened by Sir Arthur Newsholme. Pp. 102. (London: Longmans, Green, and Co., n.d.) 3*s.* 6*d.* net.

Leeds University. Fourteenth Report, 1917–18. Pp. 111. (Leeds: Jowett and Sowry, Ltd., n.d.)

The Annual of the British School at Athens. No. xxii. Sessions 1916–17, 1917–18. Pp. vii+272+plates xi. (London: Macmillan and Co., Ltd., n.d.) 25*s.* net.

DIARY OF SOCIETIES.

THURSDAY, June 12.

Mathematical Society, at 5.—Prof. G. A. Miller: Groups Involving Three and only Three Operators which are Square.—L. J. Mordell: Some Series whose *n*th Term Involves the Number of Classes of Binary Quadratics of Determinant $-w$.—Dr. W. P. Milne and Dr. D. G. Taylor: The Significance of Apolar Triangles in Elliptic Function Theory.—C. V. H. Rao: The General Theory of Ruled Surfaces.

Optical Society, at 7.30.—S. D. Chalmers: The Recognition of Detail.

FRIDAY, June 13.

Physical Society, at 5.—B. Van der Pol, jun.: A Comparison of the Wave-form of the Telephone Current produced by a Thermal Detector and a Rectifier in the Heterodyne Reception.—E. Wilson and E. F. Herroun: The Magnetic Properties of Varieties of Magnetite.

Royal Astronomical Society, at 5.—Rev. J. G. Hagen: The Light Curves of Long-period Variables.—Miss E. Bellamy: A Curious Instance of Opposite Proper Motions.—H. S. Jones: Results obtained from Seven Years' Observations made with the Cookson Floating Zenith Telescope at the Royal Observatory, Greenwich.—J. H. Reynolds: The Distribution of Hydrogen and Nebulium in the Orion Nebula.—Rev. A. L. Cortie: The Spectrum of Nova Aquilæ, 1918, August 23 to October 23.—*Probable Paper:* W. Moss: The Eruptive Prominence of 1919, May 29—communicated by the Director of the Solar Physics Observatory, Cambridge.

Malacological Society, at 6.—G. C. Crick: *Ammonites navicula* (Mantell).—R. Bullen Newton: A Sandstone Cast of *Aturia aturi* (Basterot) from the Miocene of Western Australia.—A. S. Kennard and B. B. Woodward: The Generic Names for the Two British *Ellobiidae* [olim *Auriculidae*] *myosotis*, Draparnaud (=*denticulata*, Montagu) and *bidentata*, Montagu.—G. Despott: The Mollusca of Marsascirocco Harbour, Malta.—Tom Iredale: Notes on Polyplacophora. Part II.

MONDAY, June 16.

Victoria Institute, at 4.30.—The Right Hon. the Earl of Halsbury, President: Annual Address.

Royal Geographical Society, at 8.30.

TUESDAY, June 17.

British Association Geophysical Discussions (Royal Astronomical Society), at 5.—Dr. C. T. R. Wilson and J. H. Jeans: Atmospheric Electricity.

Royal Statistical Society, at 5.15.—Mrs. Walter J. Barton: The Course of Women's Wages.

Zoological Society, at 5.30.—E. Heron-Allen and A. Earland: Exhibition of Lantern-slides Illustrating the Cultivation of *Verneuilina polystropha*, Reuss., in Hypertonic Sea-water and Gem-sand.—C. Morley: Equatorial and other Species and Genera of African Ichneumonidæ.—Dr. C. W. Andrews: A Description of New Species of Zeuglodons and Leathery Turtle from the Eocene of Southern Nigeria.—G. A. Boulenger: (1) A List of the Snakes of West Africa from Mauritania to the French Congo. (2) A List of the Snakes of North Africa.

Mineralogical Society, at 5.30.—A. Brammall: Andalusite (Chiastolite): Its Genesis, Morphology, and Inclusions.—R. H. Rastall: The Mineral Composition of Oolitic Ironstones.—L. J. Spencer: Eighth List of Mineral Names.

Royal Anthropological Institute, at 8.15.—J. Reid Moir: Flint Implements from the "Middle" Glacial Gravel at Ipswich.

WEDNESDAY, June 18.

Royal Meteorological Society, at 5.—Col. Sir Charles Close: Note on the Rainfall at Southampton and London during a period of 57 years (1862–1918), with Special Reference to the Monthly Means.—Lieut. J. Logie: Note on Tornadoes.—Capt. D. Brunt: A Periodogram Analysis of the Greenwich Temperature Records.—Lieut. G. Green: The Propagation of Sound in the Atmosphere.

THURSDAY, June 19.

Institution of Mining Engineers, at 11.—Lt.-Col. D. Dale Logan: (*a*) The Difficulties and Dangers of Mine-rescue Work on the Western Front, and Mining Operations carried out by Men wearing Rescue-apparatus; (*b*) Accidents due to Structural Defects of Apparatus or Injury to Apparatus, and the Future of the Proto Apparatus.—M. W. Blyth and L. T. O'Shea: The Examination of Coal in Relation to Coal-washing.—Prof. F. W. Hardwick: Reply to the Discussion on his Paper on the Training of Students in Coal-mining, with Special Reference to the Scheme of the Engineering Training Organisation.—W. Maurice: The Education of Colliery Managers for Administrative and Social Responsibilities.

Royal Society, at 4.30.—Bakerian Lecture. Hon. R. J. Strutt: Phosphorescence and Fluorescence in Metallic Vapours.

Institution of Mining and Metallurgy, at 5.30.—W. H. Goodchild: The Genesis of Igneous Ore Deposits.

Chemical Society, at 8.

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THURSDAY, JUNE 19, 1919.

TEXT-BOOKS OF BOTANY.

(1) *Eléments de Botanique.* Par Prof. Ph. Van Tieghem. Tome i., "Botanique Générale." Cinquième édition, revue et corrigée par Prof. J. Costantin. Pp. xv+619. Tome ii., "Botanique Spéciale." Cinquième édition, remaniée et augmentée par Prof. J. Costantin. Pp. xx+743. (Paris: Masson et Cie, 1918.) Price 14 francs.

(2) *Botany: A Text-book for Senior Students.* By D. Thoday. Second edition. Pp. xx+524. (Cambridge: At the University Press, 1919.) Price 7*s*. 6*d*. net.

(3) *Lowson's Text-book of Botany (Indian Edition).* Revised and adapted by Birbal Sahni and M. Willis. With a preface by Dr. J. C. Willis. New and revised edition. Pp. xii+610. (London: W. B. Clive, University Tutorial Press, Ltd., 1919.) Price 8*s*. 6*d*.

(1) THE latest edition of Prof. Ph. Van Tieghem's text-book, edited by Prof. J. Costantin, is arranged on the same plan as previous editions. A serious omission from the point of view of the bibliographer is the absence of any prefatory note or introduction. The first volume is described on the title-page as "revue et corrigée," and the second as "remaniée et augmentée," but there is no indication as to the extent or nature of the changes or additions by virtue of which the present edition may be regarded as an advance on earlier ones. A careful comparison of the table of contents and the text is therefore rendered necessary. There is very little change in the first volume—that dealing with general botany. The first five chapters deal respectively with the body of the plant as a whole, the root, stem, leaf, and flower—in each case treated under two sections: (1) form and structure, and (2) function. This treatment will probably not commend itself to teachers in this country at the present time, if only from the difficulty it involves in presenting an account of the physiology of the plant as a living whole. In the next four chapters an account is given of the life-history of the four great subdivisions of the plant kingdom—Seed-plants, Vascular Cryptogams, Mosses, and Thallophytes. The difference between the origin or products of germination of the spore in the fern and in the moss, as contrasted with each other and with the seed-plant, is emphasised by the use of special terms—the spore and sporangium of the fern are termed "diode" and "diodange," those in the moss "tomies" and "tomiange," the whole sporogonium of the moss being a "tomiogone."

Vol. ii., "Special Botany," deals with classification. Two subkingdoms are recognised—Arhizophytes, or plants without roots, including the two great divisions Thallophyta and Bryophyta; and Rhizophytes, or plants with roots, including the great divisions Vascular Cryptogams and Phanerogams. The subdivision and systematic treatment of the first three divisions are on familiar lines, but those of the Phanerogams are widely different from other systems which have been generally used, such as that of Bentham and Hooker, which grew out of the French system of Jussieu and De Candolle, or that of Engler, which was a development of Eichler's system. The system employed in the present volume is based on that elaborated by Van Tieghem in his paper entitled "The Eggs of Plants considered as a Basis of Classification" (*Annales d. Sci. Natur.*, sér. 8, xiv.). The Astigmatées (Gymnosperms) fall into two classes—Natrices with motile male cells, and Vectrices with male cells non-motile. The Stigmatées (Angiosperms) include three classes—Monocotyledons, Liorhizal Dicotyledons, and Dicotyledons. The second is an extremely artificial group, containing the grasses and water-lilies (except Nelumbium). For the subdivision of the other two great groups of Angiosperms the details of the structure and development of the ovule are regarded as supplying the most important characters. Special stress is laid on the persistence or absorption of the wall at the upper part of the embryo-sac; if this remains intact up to the time of fertilisation, the ovule is described as "perpariété"; if, on the other hand, the wall has been absorbed before the arrival of the pollen-tube, the ovule is "transpariété." Space does not allow of a detailed criticism of the system, which provides many puzzles for the British botanist who approaches it with preconceived ideas of affinities based on a knowledge of either of the systems to which reference has already been made.

(2) The second edition of Mr. Thoday's admirable elementary text-book differs from the original edition of 1915 in the addition of a small supplementary section on Cryptogams arranged to cover the syllabus for the Cambridge Higher School Certificate and similar examinations. The fifty additional pages contain descriptions of the structure and life-history of selected algæ, fungi, mosses and liverworts, and ferns. The examples chosen are all common genera, and illustrate, so far as possible in the small space allotted, the variety in methods of reproduction among the algæ and fungi, while the relation between the sexual and spore-bearing generations of the two higher groups is treated in sufficient detail to emphasise the principle of alternation of generations, and to render possible a comparison between the life-history of the higher Cryptogams and the Seed-plants.

As in the former edition, the body of the text is divided into five sections. In the first section the functions of plant-organs and the work of nutrition are treated experimentally; the second deals with the form and structure of the vegetative organs of seed-bearing plants, and the third with the flower, seed, and seedling. Section iv., on "The Classification of Plants," comprises, first, a study of the floral types in the family Ranunculaceæ, to illustrate the concept of species, genus, and family, and the principles of floral evolution; and, secondly, a description of other floral types as illustrated by a judicious selection of fifteen

families of dicotyledons and monocotyledons. The fifth section, "Plants in Relation to their Environment," contains chapters on "fitness" or adaptation to environment, a very useful one on trees, one each on climbing plants and water-plants, and a brief introduction to the study of plant associations.

(3) The new edition of "Lowson's Text-book of Botany," adapted for the use of Indian students, represents a widely different type of text-book. It contains a great deal of information clearly expressed in numbered and headed paragraphs, which are illustrated by plain, carefully indexed diagrammatic sketches such as a lecturer would use for a class of elementary students. It suggests the lecture notes made by an accurate and conscientious student, and if regarded as such may serve a useful purpose provided the student can clothe the skeleton with the living and working tissue. But it is not a book to put into the unaided hands of a beginner, or to excite a love of botany in the heart of the amateur. Like the original, which is well known among a certain class of students, it is obviously written for examination purposes. In the new edition Mr. Sahni has introduced additional matter into the chapters on the natural orders dealing specifically with the Indian flora, and also a number of vernacular plant-names, which are separately indexed at the end of the volume. These are both useful additions, but when one recalls the richness of the Indian flora and its remarkable diversity, ranging from tropical to high alpine, and including biological groups of great variety and interest, one could wish for a more attractive and living introduction to its study.

OPTICS AND MECHANICS.

(1) *Mirrors, Prisms, and Lenses. A Text-book of Geometrical Optics.* By Prof. James P. C. Southall. Pp. xix + 579. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 17*s*. net.

(2) *Notes, Problems, and Laboratory Exercises in Mechanics, Sound, Light, Thermo-mechanics, and Hydraulics. Prepared for Use in Connection with the Course in Natural and Experimental Philosophy at the United States Military Academy.* By Prof. Halsey Dunwoody. Pp. v + 369. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 13*s*. 6*d*. net.

SCIENTIFIC writers in the United States appear to have laboured under smaller difficulties due to war conditions than British authors. Here are two new American text-books, of which the first is sure to be welcomed by a wide circle of readers, whilst the second is adapted for a special class of students.

(1) Prof. Southall is known as the author of a treatise on "The Principles and Methods of Geometrical Optics." The present volume, although in some sense an abridgment of the larger work, contains a considerable mass of new and original material. It is intended to serve as an introduction to the theory of modern optical instruments, but only the simplest mathematical processes have been employed. In the earlier and more elementary portions of the subject the author has purposely entered into much detail, and he has been very successful in imparting fresh interest to an old and well-worn subject. The need for a text-book dealing with ophthalmology and applied optics on modern lines has long been felt, and there is no doubt that certain portions of this volume will be helpful to the modern oculist and optometrist. Thus, for example, the author has been at some pains to explain the fundamental principles of ophthalmic lenses and prisms. It is unfortunate that lack of space prevented the detailed description of any single optical instrument, and it may be suggested that an account of the microscope should be included in a future edition even at the expense of some other sections. The book is provided with a number of problems appended to each chapter, and with clearly executed diagrams. The photographic illustrations of reflection from plane mirrors are of special interest.

"Unfortunately, at present geometrical optics would seem to be a kind of Cinderella in the curriculum of physics, regarded perhaps with a certain friendly tolerance as a mathematical discipline not without value, but hardly permitted to take rank on equal terms with her sister branches of physics. On the contrary, it might be inferred that any system of knowledge which had already placed at the disposal of scientific investigators such incomparable means of research as are provided by modern optical instruments, and which has found so many useful applications in the arts of both peace and war, would be deserving of the highest recognition, and would be fostered and encouraged in all possible ways."

Prof. Southall's book should serve to stimulate the study of optics in our colleges and universities.

(2) It is difficult to understand the principles on which Prof. Dunwoody has arranged the miscellaneous contents of this volume. The title on the cover of the book is even more misleading than that on the title-page. It is "Laboratory Exercises, Notes, and Problems in Physics." Yet only about twenty pages are concerned with "Sound, Light, Thermo-mechanics," and about ten with "Hydraulics." The greater part of the contents is concerned with "Mechanics," about 150 pages being devoted to "Notes on Mechanics," including graphical statics and the mathematical treatment of translation and rotation in the case of a rigid body. About an equal number of pages is given to an extensive list of problems ranging in difficulty from those suitable for schoolboys beginning the subject to those requiring a knowledge of differential equations. In some cases hints for the solution of the problem are added.

Of the laboratory exercises, fifteen in all, thirteen are on mechanics, including one on the

viscosity of fluids, two on light, and one on sound. The exercises are illustrated by half-tones, but as no written description of the apparatus is given it is difficult in some cases to guess how the experiment is to be carried out. The student would often be at a loss if guided by these notes alone. H. S. ALLEN.

SECRET OR MYSTERY?

(1) *The Secret of Personality: The Problem of Man's Personal Life as Viewed in the Light of an Hypothesis of Man's Religious Faith.* By Dr. George Trumbull Ladd. Pp. ix+287. (London: Longmans, Green and Co., 1918.) Price 7*s*. 6*d*. net.

(2) *The Philosophy of Mr. B*rtr*nd R*ss*ll. With an Appendix of Leading Passages from Certain Other Works.* Edited by Philip E. B. Jourdain. Pp. 96. (London: George Allen and Unwin, Ltd., 1918.) Price 3*s*. 6*d*. net.

(1) IT is said that the reader of a once famous book entitled "The Secret of Hegel" remarked when he closed the volume that whatever the secret might have been it had been very successfully kept. No difficulty of discovery is likely to baffle the reader of Dr. Ladd's "Secret of Personality." His secret is an open one, and in the author's genial treatment personality is not mysterious either in the sense of inspiring awe or in that of suggesting occult sources of knowledge. Philosophy itself throws a strange light on man's personality in the attraction it has for us in our youth and in our old age, with the eclipse of interest it undergoes in the stress of active life. So in this little book we feel the professor's keen enjoyment in his old age (he was born in the same year as M. Clemenceau), writing not to instruct us, not to guide us in metaphysical or psychological research, not even to console us, but to give expression to his own reflections on the problems of philosophy.

(2) Mr. Jourdain's satire on the work of a contemporary philosopher will afford much amusement to those who are familiar with that philosopher's method and with the kind of problems to the solution of which he devotes his energy and ingenuity. To those who do not know this work or are uninterested in it, not only will the humour be lost, but the object of the book will also be unintelligible. To such it will appear a cryptic puzzle not worth trying to solve. Yet some of the papers are excellent for their logical nonsense, and might themselves be set as subjects for a logical seminar. Particularly good is the one entitled "The Mortality of Socrates." What one cannot help feeling, however, in regard to the whole is that the author satirised is himself endowed with a very abundant fund of humour which makes its presence felt in the most ultra-mathematical and logical disquisitions, and many of Mr. Jourdain's brightest hits are jokes concerning his author's jokes. Moreover, a joke prolonged into a book tends to become so serious as to threaten to defeat its intention.

OUR BOOKSHELF.

Mikrographie des Holzes der auf Java vorkommenden Baumarten, im Auftrage des Kolonial-Ministeriums. Unter Leitung von Prof. J. W. Moll, bearbeitet von Dr. H. H. Janssonius. Fünfte Lieferung. Pp. 337–764. (Leyden: E. J. Brill, 1918.)

THE present part completes the third volume (dealing with the calycifloral section of Dicotyledons) of the detailed description of the minute structure of the wood of the tree species occurring in Java. It comprises the families Rhizophoreæ, Combretaceæ, Myrtaceæ, Melastomaceæ, Lythrarieæ, Samydaceæ, Datisceæ, Araliaceæ, and Cornaceæ, and includes the description of 124 species and varieties. At the beginning of the account of each family are given a list of the literature, an enumeration of the material examined, and a summarised description of the general characters of the anatomy of the wood and its constituent elements. Then follow, first, a discussion of the bearing of the results of the investigation on the systematic grouping of the genera and species within the family; secondly, a table in the form of a key for the determination of the species by means of characters afforded by their wood-structure; and thirdly, a detailed description of the characters in each species, with a block illustration of the first species described for each genus. The authors have brought together much detailed information on the minute structure of the wood of the species examined, and the work when completed will form a valuable contribution to the systematic study of genera and species from a point of view which hitherto has been insufficiently recognised.

Molecular Physics. By Dr. James Arnold Crowther. Second edition. (Text-books of Chemical Research and Engineering.) Pp. viii+190. (London: J. and A. Churchill, 1919.) Price 6*s*. net.

THE fact that a second edition of Dr. Crowther's little volume has been required so soon shows that the praise given to the first edition in NATURE for March 25, 1915, was not undeserved. A complete revision of the material has been carried out, and, in spite of the conditions of a great war not being favourable to theoretical research, some additions have been made. In particular, the results obtained in the laboratory of Sir Ernest Rutherford have increased our knowledge of the structure of the atom, and the author has added a special chapter on this profoundly interesting subject, while the chapter on the chemistry of the atom has been almost completely rewritten from the point of view of Sir J. J. Thomson's theory of valency and chemical affinity. The complaint as to the absence of an index in the earlier edition has been at least partly met by a subject index occupying a couple of pages. In its revised form it is certain that the book will be well received, and will be read not only by physi-

cists, but also by those engaged in other scientific pursuits who desire trustworthy information as to the "new physics." H. S. A.

Le Rocce. Concetti e Nozioni di Petrografia. By Prof. E. Artini. Pp. xx+636+Tav. xxxii. (Milano: Ulrico Hoepli, 1919.) Price 18.50 lire.

PROF. ARTINI states in his preface that there has been no general treatise on rocks in the Italian language since that by Achiardi, published thirty years ago. He rightly remarks that a translation is always an indifferent expedient; a book for Italians should be rich in Italian examples. He looks on rocks from the point of view of a naturalist, and his use of landscapes among his illustrations makes us hope that he will some day give us a petrography of Italy that will connect mineral evolution with the scenery from Monte Bianco to Catania. The material here brought together is thoroughly up to date; we may cite, for instance, the remarks on *idrogels* (p. 186), on bipyramidal quartz (p. 338), and on the alleged gneissic *Grundgebirge* (p. 544). Graphic methods of representing rock-composition are illustrated. As an Italian detail, may we point out (p. 319) that *gabbro,* and not *eufotide,* is of Tuscan origin, the name of a Tuscan village having been utilised by von Buch? The treatment of sedimentary rocks is unusually adequate, and the photographic plates of thin sections are extremely clear and helpful. This compact volume is so full of fundamental *concetti* that it certainly should have been provided with an index. G. A. J. C.

Agricultural Bacteriology. By Dr. H. W. Conn. Third edition, revised by H. J. Conn. Pp. x+357. (Philadelphia: P. Blakiston's Son and Co., 1918.) Price 2 dollars net.

WHILE the general plan of this book remains the same as before, considerable changes have been introduced in the sections on soil bacteriology, on the control of milk supplies, on plant diseases, and on laboratory technique. In some cases, however, further information might have been given with advantage; thus under slimy or ropy bread practically no description is given of the causative organism. Under "tuberculosis" the illustration Fig. 50 is stated to depict "a bit of animal tissue"; what is actually shown is a giant cell only; the tubercles are stated to be "swollen masses of tissue," and among animals that suffer from tuberculosis dogs and cats are mentioned; actually these animals rarely suffer from the disease. The consideration of the bacteriology of the soil, of milk, and of milk products is adequate, and such details as protozoa in the soil and soil sterilisation and the possibility of the accumulation of toxic substances in "worn-out soils" are all referred to. In an appendix a scheme of laboratory work is given, with detailed exercises, which should be of value to the teacher. The book is freely illustrated and clearly printed, and forms a good elementary introduction to the wide subject of agricultural bacteriology.

R. T. H.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Wireless Telephony.

REFERRING to my letter on this subject in NATURE of June 12, Mr. Godfrey Isaacs tells me that his wireless remarks with regard to secrecy were intended to apply, not to the apparatus actually in use on May 28, but to a new Marconi system, the apparatus for which is only now in course of manufacture. The scientific world will, I am sure, await with interest details of this new secret wireless telephone system.

A. A. CAMPBELL SWINTON.

40 Chester Square, London, S.W.1, June 17.

Camouflage of Ships of War.

PROF. KERR, in the course of a letter which appeared in NATURE of May 15 under the above heading, paid me a high tribute by stating that, during the summer of 1917, "the value of the principle [*i.e.* obliterative colouring] was now recognised [by the Admiralty] and its application entrusted to skilled hands," but the main point in his letter was to show that the principle of obliterative colouring was no new thing, and was common knowledge to biologists: this no one will question. My aim in replying to his letter is with the view of showing that I was not working on biological lines, and is thus to remove a misapprehension.

I feel that Prof. Kerr has not thoroughly grasped the idea of the special form of camouflage on which I was engaged, and of which I still claim to be the originator. "Dazzle-painting," so called officially, had one purpose in view only, viz. to upset a submarine commander's estimate of a vessel's course, when carrying out an attack with torpedo. I was under no misapprehension as to its value for gunnery, and in my original submission to the Admiralty in May, 1917, I made no claim that it might be used for this purpose, as I felt certain that paint could not possibly have sufficient carrying power to stultify the enemy's range-finders at the great distances at which a modern action would probably be fought.

Subsequent experiments on dazzled ships with range-finders justified this belief.

The accurate estimation of a vessel's course is the prime factor required by a submarine commander to ensure successful attack. In every dazzle design this point was studied to the exclusion of all others, *i.e.* to frustrate accurate calculation of course. The mere breaking up of a vessel's form by strongly contrasting colours would not achieve this end without careful study of the perspective and balance of the design. I am not aware that this occurs in biology, *i.e.* the disguise of direction.

Surely the obliterative colouring of birds and animals is operative only so long as the bird or animal is in a state of rest; the moment movement commences the illusion is destroyed. The ship subject to torpedo attack is in constant movement. Again, in how many cases is Nature's scheme for protection successful when the subject is seen on a ridge silhouetted against the sky? Yet this is the only point of view from a submarine when observing a ship through the periscope.

My contention throughout has been that the degree of visibility of a vessel was of little consequence providing she could be seen at all. Prof. Kerr agrees that it is not possible to render a ship strictly invisible, but only to reduce her visibility. This in my view is not enough. A submarine commander, whose one object is to sink ships, will not be put off by reduced visibility. We know from some of the commanders themselves that they constantly located a vessel by its smoke when still hull down, *i.e.* before the vessel itself could be seen at all.

Prof. Kerr says that of the various methods which Nature makes use of, there are two alone of practical value for application to ships: (*a*) obliterative colouring; (*b*) compensative shading. I have endeavoured to show that the contrasting colours, as used in dazzle-painting, were not used in Nature's way, *i.e.* as obliterative colouring.

To turn to compensative shading, I must say, after extended observations at sea, I have failed to observe any gain in this method of painting. In a letter of this length it is not possible to go into all the causes of its failure, but only to state briefly one or two of the main objections. To take the practical side first, what shadows are there in our modern battleships to compensate which would retain white paint for more than a few hours? The various controls on the mast are in close juxtaposition to the funnel, and subject to constant heat and smoke. The hawse-pipes are rusty after a few hours' steaming, while the shadow cast by the flare of the bow is automatically compensated by reflected light thrown up from the bow wave. There is a small shelter deck amidships, far too deep shadow for any light paint to overcome.

In the case of the merchant vessel the same difficulties arise. No shadows cast by passenger decks can be overcome by the use of white paint, which is itself dependent on light for luminosity. These decks present a very different proposition from a bird's breast receiving reflected light from the ground or sand on which it stands, or from the glitter of water below. I am not theorising in making these statements; they are the direct outcome of observation at sea for some years.

There is one point I should like to emphasise in the matter of ships' camouflage, and that is, the practical application of a design to a ship. A scheme may be evolved which appears perfect on paper, but the result, when actually applied, will be most disappointing. Most theorists with whom I have come in contact—and they are many—only think in "one ship" when evolving a scheme for disguise. What has to be realised is that it is necessary to deal with hundreds of ships, painting simultaneously and at high pressure. The authorities concerned with shipping during the war could not think of any delay in unloading and getting vessels to sea in the shortest possible time. Consequently the painting of these vessels had to be carried out while loading or unloading, and under every other disadvantage, such as rain and coal dust. We were sometimes able to get a hose on to parts of a ship blackened with coal dust whilst painting, sometimes not. So that I fear so subtle a thing as compensative shading would have vanished before a vessel put to sea. It may be mentioned here that more than 3000 British ships alone were dazzle-painted in the last eighteen months of the war, and we sometimes had as many as a hundred vessels painting in one port simultaneously.

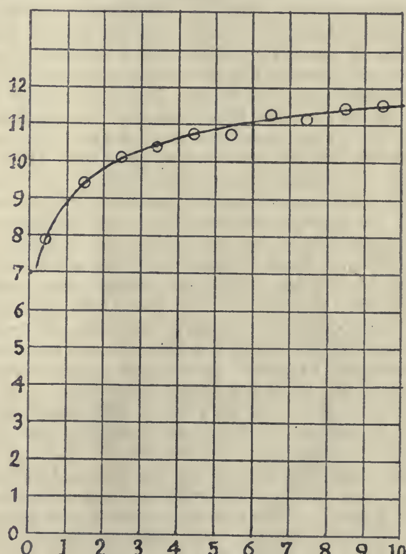
It should be remembered that dazzle-painting was adopted at a time when twenty to thirty ships were being sunk weekly, so that the life of the nation depended on turning ships round and getting them to sea again in the shortest possible time.

Dazzle-painting was never intended for use on "ships of the line," but only for merchantmen singly or in convoy and war vessels working with them; and, judging from the great number of reports received from merchant captains, who in the early stages of dazzle-painting were averse to it, but later came to see its object, there can be no question that it achieved its purpose. NORMAN WILKINSON.

Question Relating to Prime Numbers.

IT is well known that no algebraical formula can represent prime numbers only, and that primes can only be found by trials (which may be facilitated by algebraical processes). If the m^{th} prime number, counting from unity, be denoted by n, and if n is plotted in terms of m, it will be found that n is very approximately represented by a formula of the type Am^p ($A=3{\cdot}15$, $p=1{\cdot}133$, are close to the values of the constants).

The differential of this curve is given in the accompanying diagram, and the true values of dn/dm are



m. in Thousands

⊙ – *Average difference of successive Thousands of prime numbers*

Full Curve.– Differential of $3{\cdot}15\,m^{1{\cdot}133}$

shown by the circles. The agreement between the curve $3{\cdot}15\ m^{1{\cdot}133}$ and the true values of n (taken from Barlow's tables) is too close to be shown with advantage on the scale to which the diagram is drawn. The differential curve is a good mean of the actual values of dn/dm.

Are there any investigations which give a reason for the tendency of n to approach a definite function of m, or as to the ultimate value of dn/dm when m increases without limit? A. MALLOCK.

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THE ATLANTIC FLIGHT.

THE honour of the first direct trans-Atlantic flight, for which the *Daily Mail* offered a prize of 10,000*l.*, has fallen to two English aviators on a British machine. The Vickers "Vimy" bomber has made the crossing, with Capt. J. Alcock as pilot, and Lt. Whitten Brown as navigator. Newfoundland was left at 4.25 p.m., G.M.T., on June 14, and a landing made at Clifden, Galway, at 8.40 a.m., G.M.T., on June 15. The machine is a standard bombing aeroplane, slightly modified for the present flight, and has a span of 67 ft. It carries two Rolls-Royce engines of 375 h.p. each, and the gross load is about 12,500 lb. The passage was made in 16 hours 15 min., giving an average speed of nearly 120 miles per hour. The wind was favourable, but the weather very bad, according to the report of the aviators. Clouds were met at all altitudes, and it was generally impossible to see either ocean or sky. At the higher altitudes the machine became covered with ice, and at one time the air-speed indicator became clogged, thus robbing the pilot of his best guide as to the attitude in which he was flying. The sense of horizontality was for the time lost, and the machine executed various evolutions until it had fallen so low that the sea became visible, and Capt. Alcock was able to recover a normal attitude.

Only four observations of position were taken during the flight, these being made with reference to the sun, the moon, the Pole star, and Vega respectively. Under these adverse conditions the precision with which the correct course was kept is very remarkable. All ships were warned that the flight was taking place, and asked to wireless their positions, but the aviators received no messages to guide them, and were entirely dependent on their own scanty observations.

Owing to the favourable wind, only two-thirds of the petrol was used during the flight, and the time of crossing was but two hours more than the minimum that had previously been calculated for the most favourable conditions possible in the North Atlantic. The average altitude was about 4000 ft., but attempts were made to find better atmospheric conditions at various altitudes up to 11,000 ft. without success.

The flight may well be regarded as one of the most wonderful feats of recent times, and the two brave aviators are to be heartily congratulated on their great achievement in the face of such enormous difficulties. It is probable that an early start was made, in spite of bad weather reports, owing to the fact that the Handley-Page machine was almost ready for flight. The circumstances of Hawker's attempt were thus repeated, but this time no engine trouble was experienced, and the passage was successfully completed in worse weather than that with which Hawker had to contend. The primary importance of engine trustworthiness has often been commented upon, and the history of the Atlantic attempt has strikingly demonstrated it.

It is of interest to note that both Messrs. Vickers and Handley Page are believers in methods of design based upon model experiments, and that both firms possess their own wind-tunnel equipment by means of which such experimental data can be obtained.

It is only ten years since the first flight across the Channel was made, and now the Atlantic has been flown under extremely adverse conditions. Such a record of rapid progress surely leaves room for the most optimistic views of the future possibilities of aviation as a rapid means of communication between distant parts of the world.

Weather Conditions.

On Friday night, June 13, the Air Ministry reported "Conditions are favourable from west to east. A belt of high pressure extends across the Atlantic, just south of the course. . . ."

The wireless reports of weather issued by the Meteorological Office show that the winds during the flight all had a large amount of westing in their direction, and on the eastern side of the Atlantic the weather was cloudy, with some rain. The telegraph s.s. *Faraday*, at about 20° W. long., in close proximity to the aeroplane, at 1 a.m. June 15, had a moderate south-westerly gale with rain. Much of the excess speed throughout the flight is doubtless due to the brisk following wind, and to have achieved the journey in sixteen hours from coast to coast is an accomplishment not to be easily beaten.

At this time of year the disturbances moving generally north-eastwards across the Atlantic are usually at their most northern limit, and the strongest winds experienced on the track of steamships or aircraft have a large amount of westing. Fog, however, is at its worst in the summer season, whilst on the western side of the Atlantic sleet and snow would probably have to be encountered at the height of 2000ft. or more, at times, at any season of the year.

BRITISH PETROLEUM.

SO long ago as 1896 the late Sir Boverton Redwood examined a sample of oil from Ashwick Court, near Shepton Mallet, and reported that it was straw-coloured, transparent, and free from fluorescence. The odour was reminiscent of refined petroleum, the specific gravity was 0·816, and the flash point (Abel) 175° F. In 1906 he wrote: "A considerable number of other districts where petroleum similarly occurs are known, and, although it has been suggested that some at least of the deposits may have been produced by a natural process of distillation from coal or bituminous shales, there is no reason to doubt that most of them are true petroleum, and are quite distinct from the oils which are obtained by known processes of distillation from either coal or shale." Later, in 1911, Sir Boverton examined and reported on an oil from a well at Kelham, and stated that the material should be regarded as a "true normal petroleum," and in 1914 he advocated that the bore hole should be deepened, believing that "more productive strata might be found at greater depth." It is a strange coincidence, not untouched by the irony of fate, that the last piece of work carried out before he died was the analysis of the Hardstoft oil.

The Hardstoft oil was struck at a depth of 3077 ft., and at the outset flowed into the bore hole at the rate of about 350 ft. per day. Sir Boverton Redwood's analysis is as follows:—

A limpid oil of dark brown colour by transmitted light, but exhibiting strongly marked green fluorescence and of characteristic odour. The oil contained only a trace of water, and possessed the specific gravity of 0·828 at 60° F.

Flash point (Abel), 73° F.

Distilling below 150° C.; 4·5 per cent. by volume.

Distilling between 150°–300° C.; 41·0 per cent. by volume; sp. gr., 0·783; and flash point, 105° F.

Mr. Hackford's percentage analysis is as follows:—

Motor spirit, 7·5	Lubricating oils, 30·5
Kerosene, 39·0	Paraffin wax, 3·0
Gas oil, 20·0	Sulphur, 0·26

Specific gravity, 0·823.

Chemical characteristics: Paraffin base containing naphthene.

It is clear that the oil is of high grade, and if the wells yield it in quantity the country will possess an asset of inestimable value.

During the past week the casing has been fitted with a valve and a line to a receiving tank, into which oil is flowing at about 400 gallons per day. No water at present has been found with the oil. The 8½-in. casing is now at the bottom of the hole, and drilling has been resumed. The evidence so far indicates that a true oil rock has been penetrated, and that the oil is neither a filtrate nor has it migrated. Whether or not the distribution of the oil is local and limited or extensive and in quantity time alone will show.

Active work is in progress at Brimington, where the hole is 2660 ft. deep, and at Renishaw, where 2950 ft. have been penetrated. At any time oil may be struck in these localities.

Drilling may be expected shortly near Newark, where, at Kelham, oil has previously been observed, and a licence from the Ministry of Munitions has been issued to the Oil Field of England, Ltd. The Kelham show was a somewhat heavier oil than that from Hardstoft, and on being topped it yielded 91·4 per cent. of fuel oil. Provision is being made to drill down to 4000 ft., the first strike having been made at 2440 ft. in 1911.

In the Midlothian district Messrs. S. Pearson and Sons, Ltd., are pushing on with the preliminaries for drilling down to 4000 ft. through the shale seams. Success in this project would indicate a new lease of activity for the Scottish shale industry.

FATHER WALTER SIDGREAVES, S.J.

FATHER WALTER SIDGREAVES, S.J., the director of the Stonyhurst College Observatory, died, after a lingering last illness, at Stonyhurst on June 12 in his eighty-second year. He had been ailing and failing in strength for the last six months, but with indomitable courage he carried on the routine work of the observatory to within a month of his death.

Sidgreaves was born on October 4, 1837, the second son of Edward Sidgreaves, of Grimsargh, near Preston; he was educated at Stonyhurst, entered the Society of Jesus in 1855, and was ordained priest in 1871. He was for two periods director of the observatory at Stonyhurst, first during the years 1863–68, while the late Father Perry was engaged in his theological studies, and secondly, after the death of Father Perry in 1889, on the total solar eclipse expedition at Salut Isles, French Guiana. The acquisition and erection of the equipment of the observatory, astronomical, magnetic, meteorological, and seismological, is almost entirely due to his efforts. In 1863 Sidgreaves commenced the regular series of magnetic observations which has been carried on, and in the last thirty years by himself, ever since that date. His very last observation on May 3 was of the magnetic dip. In 1866 he installed all the self-recording meteorological instruments, and in the following year purchased an 8-in. equatorial refractor. This instrument supplanted the 4-in. refractor, which, however, had the distinction of having been the first telescope systematically used by the famous Father Secchi, when he was an exile at Stonyhurst during the revolutionary troubles in Italy in 1848. After the death of Father Perry the equatorial was fitted with a 15-in. object glass, the memorial subscribed for by friends of Father Perry.

Sidgreaves took part in four expeditions as companion to his successor in office—in 1868–69, when they made a magnetic survey of the west and east of France, and in 1874 and 1882, when they observed the transit of Venus across the sun's disc at Kerguelen Island and in Madagascar. His chief papers communicated to the memoirs and monthly notices of the Royal Astronomical Society dealt with the subjects of solar physics, and more particularly of stellar spectroscopy. In his memoir, "On the Connection between Sun-spots and Earth-magnetic Storms" he came to the conclusion that the effects observed were attributable to clouds of electrons circulating between the sun and the earth. A long series of observations of the H and K lines in the general light of the sun showed that the sun approximated to the class of stars which exhibit bright as well as dark lines in their spectra. But Sidgreaves's chief researches dealt with stellar spectroscopy, and with the instruments which he devised he took a whole series of remarkably fine spectra of the brighter stars. His published papers are concerned more particularly with the spectra of o Ceti, γ Cassiopeiæ, and β Lyræ, and with the Novæ of 1892 and 1901. He was as an observer most painstaking, methodical, and accurate, and sceptical of all results that could not be thoroughly substantiated. He had all the dogged grit and perseverance of the typical Lancashire character. Being afflicted with deafness, particularly so in his later years, he avoided public appearances; but his lecture

on β Lyræ before the Royal Institution in 1904 will be remembered. His photographic work in stellar spectroscopy was awarded a gold medal in the St. Louis Exposition of 1904, and a *grand prix* by the Franco-British Exhibition of 1908.

At Stonyhurst, Sidgreaves also, in his younger years, taught mathematics and chemistry, and, as a priest, physics, to the students of St. Mary's Hall for twenty-five years with great success. Everyone who came in contact with him was attracted by his kindly and amiable disposition. He effaced himself that others might have more time for research work. He was elected a Fellow of the Royal Astronomical Society in 1891, and served for many years on its council.

NOTES.

MANY subjects of importance are to be discussed at the meeting of the International Research Council, to be held in Brussels on July 18–28. It may be remembered that the council arose out of Inter-Allied conferences held in London and Paris last year (see NATURE, December 26, 1918). Steps are to be taken at Brussels to establish the federation in its final form. The statutes of the council are to be discussed and also those of international unions of astronomy, physics, mathematics, geodesy and geophysics, and other departments of science. There will be a report of a committee on international co-operation in chemistry, and one on the foundation of the federation of societies of pure and applied chemistry. The important question of the biological exploration of the North Sea and North Atlantic Ocean will also be brought forward. The executive committee, consisting of MM. Picard (chairman), Volterra, Lecointe, Hale, and Schuster, acting upon the views expressed at the conference held in Paris in November last, has unanimously decided to recommend to the council that the following nations, which were neutral during the war, be invited to co-operate:—Denmark, Spain, Holland, Monaco, Norway, Sweden, and Switzerland. It is suggested also that Czecho-Slovakia and Finland should be considered as possible co-operating nations. The executive committee was appointed as a temporary body only, entrusted with the duty of bringing forward proposals at Brussels, and promoting the formation of national councils, the federation of which will form the International Council. It may be dissolved when the International Council is finally constituted.

IN the first issue of the *Crucible*, a magazine recently started by the science students of the University of Aberdeen, there is a characteristically trenchant article by Prof. Soddy. Under the metaphor of new wine into old bottles, Prof. Soddy points on one hand to the praiseworthy labours of the junior staffs in our universities in carrying to a high degree of efficiency the teaching of experimental science to thousands of eager students, and on the other to lack of prevision on the part of the authorities in encouraging research. It is safe to say, indeed, that the conservative instincts of the governing bodies, many members of which have not the least conception of what is meant by scientific research, tend rather to discourage than to encourage the hard-worked assistants from engaging in any form of research work. Even the Carnegie Trust for the Universities of Scotland, one of the primary objects of which was to promote scientific study and research, has expended out of its millions only some 14 per cent. on research of all kinds, including historical, linguistic, and economic subjects. According to Prof. Soddy, the *loss* on the money saved, occasioned by the depreciation of British investments during the war, would have maintained several first-class research professorships since the Trust was founded. In short, how can science as a progressive factor in civilisation get a fair chance in ancient institutions largely governed by medieval conceptions? This is virtually Prof. Soddy's complaint; and it is one calling for serious reflection and strenuous endeavour on the part of all who have the welfare of the nation at heart.

A RELIEF expedition under Capt. Godfred Hansen, of the Danish Navy, has left Copenhagen to place a depôt of stores for Capt. Roald Amundsen in Grant Land. Capt. Hansen, who in 1903–5 was second-in-command of Amundsen's expedition in the *Gjoa*, has, according to the *Morning Post*, sailed in a Danish Government vessel for Upernivik, in Greenland. In July he hopes to reach North Star Bay in lat. 76° N., where he and his party will winter. In the spring they will start north, taking Eskimo with them, and will travel *via* Cape Morton and Kennedy Channel to Fort Conger, Greeley's quarters from 1881 to 1883. The majority of the party will remain at Fort Conger and engage in hunting, while the leader and one other man will push on to Cape Columbia, a distance of about six hundred miles, in order to leave a year's rations, together with guns and ammunition and a detailed description of the route by Knud Rasmussen, the Danish explorer of North Greenland. Returning to Fort Conger, Capt. Hansen and his men will leave for Greenland in the autumn as soon as Kennedy Channel freezes. It is most improbable that Capt. Amundsen in the *Maud* will reach Grant Land next summer, since his drift across the polar basin will probably occupy at least three years, but in the event of his ship being crushed, the depôt will be invaluable. In any case, it will serve him well in the course of time, unless the *Maud* is carried east of Greenland.

ONE result of the war has been that the tendency in Germany is more and more in the direction of co-operation. From two recent translations which Sir Robert Hadfield has had prepared, to whom we are indebted for copies, we note that the technologists of Germany are convinced that technical interests can only be furthered by combination. The union of technical men was formed so long ago as last December, with the support of most of the German technical societies, for the purpose of securing for the technologist that recognition of his importance which has apparently been denied him hitherto. The new body seems to have been primarily inspired as an offset to the pernicious and undermining influence of certain groups who are trying to gain the ascendency in Germany. In the propaganda publication the Union states that a technical expert succeeded in saving some 20,000 tons of coal a month in an explosives factory without diminution of output. Another body to be formed is the German Empire Industrial League, which is a combination of existing groups, and will embrace an organisation styling itself the Joint Executive of Employers and Employed. It is hoped that all industrial interests will find expression in this new body.

WE regret to learn that official information has been received that the Cape Provincial Council, Cape Town, has decided to exterminate the herd of elephants in the Addo Bush Reserve. With the exception of a small herd in the Knysna Forest, these are the last survivors of the wild South African elephant. The animals in the Addo Bush Reserve have become a

source of danger and damage to the surrounding farms. By breaking down fences and destroying waterworks, and generally bringing about a state of terror and insecurity, they are the cause of actual damage to a serious extent. They hamper farming operations and agricultural development. Nevertheless, the drastic step that has now been decided upon cannot fail to arouse considerable dissatisfaction in the sporting and scientific world.

WE have received a copy of a proposal endorsed by many well-known scientific men for the establishment of an institute of commercial and industrial psychology and physiology. The proposal is accompanied by a summary of thirty investigations in which the scientific analysis of industrial movements resulted in a notable improvement of output, and reference is also made to the effects of shorter hours and the introduction of rest pauses. Amongst the scientific supporters of the proposals are Sir Walter Fletcher, Mr. W. B. Hardy, Lt.-Col. Myers, Prof. C. S. Sherrington, and Prof. E. H. Starling. The secretary is Mr. G. Spiller, 1 Great Tower Street, E.C.3.

MR. F. FLIPPANCE, at one time a temporary assistant in the herbarium at Kew, has been appointed assistant curator of the Botanic Gardens, Singapore.

THE Guy medal of the Royal Statistical Society for 1918–19 has been awarded to Dr. J. C. Stamp, who recently contributed papers to the society on "The Effect of Trade Fluctuations on Profits" and "The Wealth and Income of the Chief Powers."

A DIRECTOR of research is about to be appointed, at a salary of not less than 1250*l.* per annum, by the British Cotton Industry Research Association, 108 Deansgate, Manchester. Forms of application and further information are obtainable from the secretary of the association. The latest time for receiving applications for the post is July 21.

THE council of the Royal Society of Edinburgh has awarded the Makdougall-Brisbane prize for the period 1916–18 to Prof. A. Anstruther Lawson, of Sydney, for his memoirs on the prothalli of *Tmesipteris tannensis* and of *psilotum*, published in the Transactions of the society, together with previous papers on cytology and on the gametophytes of various gymnosperms.

AT the meeting of the Franklin Institute, Philadelphia, held on May 21, the Franklin medal awarded to Sir James Dewar was received by Major-Gen. J. D. McLachlan, representing the British Government, and the presentation of the Franklin medal to Major-Gen. George Owen Squier, U.S. Army, was also made. An address was given by Major-Gen. Squier on "Some Aspects of the Signal Corps in the World-War."

THE sixth lecture of the series arranged by the Industrial Reconstruction Council will be held in the Saddlers' Hall, Cheapside, E.C.2, on Wednesday, June 25. The chair will be taken at 4.30 p.m. by the Right Hon. J. H. Whitley, and a lecture will be delivered by the Right Hon. C. W. Bowerman on "Some Industrial Problems." Applications for tickets should be made to the Secretary, I.R.C., 2 and 4 Tudor Street, E.C.4.

THE annual general meeting of the Society of Chemical Industry will be held in London on July 15–18, under the presidency of Prof. Henry Louis. On Tuesday, July 15, there will be a conference at the Mansion House, when addresses will be given by representatives of the Inter-Allied Conference. Sir William J. Pope, chairman of the Federal Council for Pure and Applied Chemistry, will open the conference. The subjects of other conferences will be:—Power Plant in Chemical Works; Empire Sugar Production; Dyestuffs, Synthetic Drugs, and Associated Products; The Chrome Tanning Industry; and Recent Developments in the Fermentation Industries. A reception will be held at the British Scientific Products Exhibition, Central Hall, Westminster, on July 17.

THE New Zealand Department of Lands issued in 1918 a report on the "Waipoua Kauri Forest: Its Demarcation and Management." This forest, which has recently been demarcated by Mr. D. E. Hutchins, was made a national reserve under the State Forests Act of 1908. It covers 29,830 acres, and contains a large number of old and giant trees of Kauri, *Agathis australis*, an endemic conifer yielding a very valuable timber. The forest is in a wild state, bringing in no revenue at present. Mr. Hutchins recommends a system of management by which the old trees would be speedily felled and a young, regular growth established, which in course of time would yield an enormous revenue. The Government owns five other Kauri forests, each averaging 12,000 to 15,000 acres. As there are estimated to be about 500,000 acres of restorable Kauri forest altogether, it is desirable, perhaps, in the interests of science and of scenic beauty, that one of the five Government forests, or a portion of one, should be left in its natural state, with a fair number of the oldest trees untouched, in spite of the temptation to realise the money worth of all the finest timber.

THE North-East Coast Institution of Engineers and Shipbuilders will hold a summer meeting, which is being called the Victory Meeting, on July 9–11 in Newcastle. The meeting is the first of the kind it has held since July, 1914, when, on the eve of the war, the institution received the Institution of Naval Architects and the Institution of Engineers and Shipbuilders in Scotland at a joint meeting. Among the distinguished guests invited are Marshal Foch, Sir David Beatty, and Sir Douglas Haig, upon whom honorary fellowship of the institution will be conferred at the inaugural meeting. Papers recording the industrial work of the North-East Coast during the war will be read by Mr. A. H. J. Cochrane, Mr. M. C. James, and Mr. Launcelot E. Smith. Lady Parsons, who will receive the diploma of honorary fellowship during the proceedings, will address the meeting on "Women's Work in Engineering and Shipbuilding during the War." This will be the first occasion upon which a woman has delivered a paper before this institution. Other important papers will be read by Lord Weir of Eastwood, Lt.-Comdr. Wilkinson, Mr. Georges Constantinesco, and Prof. MacLennan. The two first-named authors deal with the subjects in which they are eminent experts: the development of aircraft during the war and thermal efficiency in Diesel and other internal-combustion engines. Comdr. Wilkinson will describe his work in the "dazzle-painting" of ships. Mr. Constantinesco will explain his new system of power transmission, and illustrate it by practical experiments. Prof. MacLennan has not yet named the subject of his lecture.

IT is well known that radiographers, if unprotected, are liable to injury by X-rays, such as "burns," intractable dermatitis which is liable to become cancerous, and sterility. Dr. Hernaman-Johnson in the Journal of the Röntgen Society (vol. xv., No. 59, p. 45) discusses the protective measures that should be taken in diagnostic work by

radiographers. He recommends that (1) the tube should be entirely enclosed in a box opaque to X-rays, and (2) *scattered* radiations should be prevented from reaching the body of the observer. The measures to be taken to fulfil these conditions are discussed. True secondary radiation is not a danger except in the case of certain metallic articles worn close to the body, and then only if the precautions named are not efficiently carried out.

BULLETIN 174 (May, 1918) of the Agricultural Experiment Station of the Rhode Island State College deals with the part played by bacteria of the paratyphoid group in the causation of disease in poultry. The authors (Philip Hadley, Marguerite Elkins, and Dorothy Caldwell) conclude that there are six principal disease types among the typhoid- and cholera-like diseases of birds:—(1) Fowl cholera, due to *B. avisepticus* of the Pasteurella group; (2) fowl typhoid, due to *B. gallinarum*, Klein, of the actual paratyphoid group; (3) paracolon infections, due to paracolon bacteria in the strict sense; (4) bacterial white diarrhœa, due to *B. pullorum* A; (5) infections in adult stock with *B. pullorum* B; and (6) infections with certain intermediate strains. The report succeeds in elucidating the bacteriology of several poultry diseases about which much confusion formerly existed.

THE World Trade Club, of San Francisco, has circulated widely copies of a letter addressed by the club to Lord Balfour of Burleigh, advocating the immediate introduction of the metric system of weights and measures in the United Kingdom. The letter points out that both Great Britain and the United States were obliged to make use of the metric system in foreign countries during the war, and urges that the adoption of the "meter-liter-gram" system is absolutely necessary in the interests of education and business, and of our foreign trade in particular. Recipients of the letter are requested to sign and dispatch the printed forms at the end, addressed to Mr. Lloyd George and President Wilson respectively, calling for legislation to bring about the exclusive use of the system in this country and in the United States.

IN the Journal of the Bihar and Orissa Research Society (vol. iv., part iii., September, 1918) Dr. W. Crooke describes a remarkable form of headdress worn by women of the Banjara tribe, wandering carriers in northern India and the Deccan. It consists of a stick or "horn" made of wood or silver, which is placed upright on the top of the head, the hair being wound round it, and over it the headcloth is draped in a graceful fashion. Numerous analogies to this form of headdress are traced in Central Asia, Assyria, among the Druses, and in ancient Indian statuary. It seems to be a mark of distinction, presumably confined to married women, and its use may ultimately depend upon the theory of the sanctity of the head. But, so far, the evidence from India does not fully corroborate this. The same is the case with the theory which would connect the Banjaras with some northern tribe, though it is possible that the Charan branch may have been priests of the Gurjaras, one of the many branches of the Hun tribes which invaded India in the fifth and sixth centuries of our era.

MESSRS. A. N. WINCHELL and E. R. Miller (Amer. Journ. Sci., vol. xlvi., p. 599, and vol. xlvii., p. 133) describe a remarkable dustfall that occurred at Madison, Wisconsin, on March 9, 1918. Microscopic examination and mechanical analysis indicate that the material is not volcanic, but merely wind-borne, and was derived from rocks physically disintegrated in a very arid climate, probably from New Mexico or Arizona. It is pointed out that a single storm may thus "transport a million tons of rock material a thousand miles or more."

MR. S. S. BUCKMAN, in a paper entitled "Jurassic Chronology: I.—Lias" (Quart. Journ. Geol. Soc. London, vol. lxxiii., p. 257, 1918), has made the most important contribution to our knowledge of Jurassic strata in the Inner Hebrides since Judd's work of forty years ago. The paper, with Mr. J. W. Tutcher's appendix on zonal sequence in the Lower Lias, covers also a wider field, and the discussion to which it gave rise shows that the gaps in the record suggested by the details of the palæontology were not immediately accepted by stratigraphers.

THE Journal of the East Africa and Uganda Natural History Society for November, 1918 (Longman, London, price 5*s*. 4*d*.) contains an account by Mr. C. W. Hobley of a volcanic eruption of Donyo L'Engai, a mountain in the trough-valley about forty miles south of the Anglo-German boundary in East Africa. This outburst occurred in January, 1917, and appears remarkable for the amount of sodium carbonate thrown out with the volcanic dust over a wide area. Mr. Hobley goes back to the old theory that metallic sodium may be a cause of volcanic eruptions; but the presence of Lake Natron a few miles to the north makes it possible that Donyo L'Engai was built up above the deposits of similar saline waters, which were blown up with the volcanic matter from below.

PROF. FILIPPO EREDIA has published an instructive paper on the climate of Gorizia in a recent issue of the *Bollettino Bimensuale* of the Meteorological Society of Italy. Gorizia is in lat. 45° 56′ N., long. 13° 37′ E., and meteorological observations have been maintained since 1870, which are discussed for the forty-five years ended 1914. The mean annual temperature is 12·7° C. (54·9° F.), the average varying from 22·8° C. (73·1° F.) in July to 2·8° C. (37° F.) in January. Pressure falls to a minimum in April, when cloud amount is highest, and is at a maximum in January. August is the sunniest month, with 63 per cent. of the total possible against 41 per cent. in April. The mean annual rainfall is 1595 mm. (62·8 in.), with extremes of 200 mm. (7·87 in.) in October and 70 mm. (2·76 in.) in January. The wettest month was October, 1889, with 497 mm. (19·57 in.), and in the Januaries of 1880 and 1888 and the Februaries of 1890 and 1891 no rain fell. Calms prevail for more than half the time, and north-east is the most frequent wind experienced in every month of the year. Snow falls on five days, hail on four days, and rain on 142 days annually. Thunderstorms are frequent, the mean annual number being twenty-eight, of which 60 per cent. occur in the three summer months. In a note entitled "Sulla Direzione delle Correnti Aeree in Sicilia," that appears in vol. xxvii. of *Rendiconti della R. Accademia del Lincei*, Prof. Eredia gives an analysis of the monthly direction of the wind for nine places in Sicily based on observations from 1891–1910, the mean direction being obtained by Lambert's formula.

ACCORDING to U.S. Commerce Report No. 85 (1919), a discovery of copper is reported from near Beaudoinville, a port at the southern end of Lake Tanganyika, Belgian Congo.

BULLETINS Nos. 9 and 10 of the Advisory Council of Science and Industry for the Australian Commonwealth are just to hand. They deal respectively with

the manufacture and uses of ferro-alloys and alloy steels from the raw materials in Australia, and with substitutes for tin-plate containers (tin cans). The latter is a specially interesting report, giving information as to the manufacture of wood and cardboard containers and of the machinery used, varnishes, the properties of the different materials, etc.

BOOKLETS have reached us from the firm of Messrs. Adam Hilger, Ltd., describing the wave-length spectrometer introduced in 1904 and various accessories which may be employed in connection with the instrument. The constant deviation prism is rotated by means of a fine steel screw, to which is fixed a drum provided with a scale of wave-lengths. In the most recent instruments this scale is on the side of the drum towards the eye, so that the wave-lengths can be read without quitting the eyepiece. In one form of the instrument provision is made for the use of a Fabry and Perot etalon, by means of which wave-lengths may be determined to a very high accuracy, or for a Michelson echelon or a Lummer-Gehrcke parallel plate for demonstrating the Zeeman effect. Another development of great importance is the improved form of polarisation photometer, based on that described by P. G. Nutting, which, when used in conjunction with the constant deviation spectrometer, provides a powerful tool for spectro-photometry. The attention of the technical chemist may usefully be directed to this method of investigation, which has already proved of service in research on dyes and on photographic plates.

IN a paper on "Electrical Phenomena occurring at High Levels in the Atmosphere," recently read before the Institution of Electrical Engineers, Dr. S. Chapman gives "a general outline of the subject, without detailed argument or references." "The account," he adds, "is not limited to what can be regarded as certain conclusions; without departing too far from the basis of observational evidence, conjectural views have also been admitted." Dr. Chapman seems finally to accept the Birkeland-Störmer theory as to the joint cause of magnetic storms and aurora being electrical ions discharged from the sun, but in opposition to Birkeland he thinks these must be α-rays, not cathode- or β-rays. During magnetic storms he accepts a highly ionised layer coming down to about 100 km. above the earth's surface. At a lower level he supposes normally existent a second conducting layer, its ionising agent being ultra-violet light, which he identifies with γ-rays. In it are the electrical currents to which the regular (solar) diurnal variation is ultimately due. Accepting as a fact that magnetic storms are not accompanied by special changes of electrical potential gradient at the earth's surface, it is supposed that the upper atmosphere is so good a conductor that the charge from the α-rays almost instantaneously distributes itself uniformly over a spherical surface, and so does not influence the electrical field at lower levels. The sudden rise and the subsequent slow decline of horizontal force characteristic of magnetic storms in low and mean latitudes are ascribed to vertical movements of the atmosphere, cutting the horizontal lines of the earth's magnetic field. "The general nature of the movement can be readily inferred. The mutual repulsion of the entangled charge spread over the world-wide spherical layer produces an upward, outward movement, as in a charged soap-bubble. Thus the air travels vertically upwards, except during the first few minutes of a magnetic storm. For at first the downward momentum of the injected particles depresses the air before the electricity has accumulated sufficiently to reverse the motion."

THE possibilities of exploitation of the River Dee, from its source in Wales to the city of Chester, for the development of low-fall water-power, economically utilisable for the generation of electrical energy, is the subject of a recently issued report by Mr. S. E. Britten, arising out of a conference held in June, 1917, by the Board of Agriculture and Fisheries. The *Engineer* for May 30 contains a *résumé* of the report, from which we gather that Mr. Britten's scheme provides for sixteen power-stations at various points along the river's course, with falls generally ranging from 7½ ft. to 12½ ft. (there is one case of a 37-ft. fall), and capable of producing in the aggregate 60,000,000 electrical units per annum. The capital cost of the scheme is estimated at 702,240*l*., and, with an average sale of about 48,000,000 units at 1½*d*. per unit, a surplus balance of 205,468*l*. is counted upon. Included in the estimate are the sixteen hydro-electric stations at 29,700*l*. each, a tunnel at 60,000*l*., and sixty-one miles of transmission line at 65,000*l*. The possibilities of the scheme for producing power are equivalent to a consumption of 70,000 tons of coal per annum. The valuable characteristics of the river for salmon-fishing have not been lost sight of. The quantity of fish caught annually is about 2500, with a gross weight of 13 tons, valued at 3750*l*. From six years' observation made in connection with the Chester Weir there is no evidence, according to the report, that the fish suffer in the least degree from the establishment of hydro-electric works.

THE following books are announced for early publication:—"Menders of the Maimed: The Anatomical and Physiological Principles underlying the Treatment of Injuries to Muscles, Nerves, Bones, and Joints," Prof. A. Keith; "Fractured Femurs: Their Treatment by Calliper Extension," Major M. G. Pearson and Capt. J. Drummond (*H. Frowde and Hodder and Stoughton*); "Psychology and Parenthood," H. A. Bruce (*W. Heinemann*); "Our Atlantic Flight," H. G. Hawker and Lt.-Comdr. M. Grieve, with an introduction by Major-Gen. J. E. B. Seely (*Methuen and Co., Ltd.*); "Opportunities in Chemistry; or, Chemistry in Everyday Life," E. Hendrick (*University of London Press*); and "Senior Practical Chemistry," H. W. Bausor (*University Tutorial Press, Ltd.*). The following works are in the press for publication by the *Carnegie Institution of Washington* (*Washington*):—"The Cactaceæ: Descriptions and Illustrations of Plants of the Cactus Family," N. L. Britton and J. N. Rose, 4 vols.—vol. i., "The Ecological Relation of Roots," J. E. Weaver; "The Carbohydrate Economy of Cacti," H. A. Spoehr; "Climatic Cycles and Tree-growth," A. E. Douglas; "Plant Indicators: The Relation of Plant Communities to Conditions and Practices," F. E. Clements; and "Hydration and Growth," D. T. MacDougal.

THE price of Norton's "Star Atlas," noticed in NATURE of June 12, was incorrectly given as 3*s*. 6*d*. The publishers ask us to point out that the selling price of the book is 8*s*. 6*d*.

OUR ASTRONOMICAL COLUMN.

THE SOLAR ECLIPSE OF MAY 29.—We have received through the office of the Scientific Attaché of the American Embassy the following message from Dr. L. A. Bauer, director of the Terrestrial Magnetic Laboratory of the Carnegie Institution of Washington, referring to observations of the total solar eclipse of May 29:—"Cape Palmas.—Complete success; inner corona very bright, marked outer corona extensions S.S.E., N.N.W.; brilliant red prominence W.S.W.; several stars seen region sun; no shadow bands; magnetic effect confirmed."

THE ASTROGRAPHIC CATALOGUE.—Reference is made in the report of the Oxford University Observatory for the past year to the progress made in certain zones of this work, which were originally allotted to the observatories that have been unable to complete their undertaking without some help. The plates taken and measured at the Vatican Observatory are reduced and published under the direction of Prof. Turner, and the printing of vol. iv., which will complete nearly half this section, is in progress. The plates taken at the Santiago de Chile Observatory are sent to the University Observatory for measurement and reduction, but the supply is slow and scarcely satisfactory. The Hyderabad Observatory, which took over a zone left undone by a South American observatory, and may be considered an offshoot of Oxford, for both its directors received their training there, has made rapid progress, but this may be somewhat hindered by the death of its young and energetic director, Mr. Pocock, to whose widow the Nizam has granted a pension of 100*l*. a year.

THE BRITISH SCIENCE GUILD.

THE thirteenth annual meeting of the British Science Guild was held (by kind permission of the Master and Wardens) at the Goldsmiths' Hall on Tuesday, June 17, the Right Hon. Lord Sydenham, president of the guild, in the chair.

The adoption of the annual report, which recorded the various activities of committees of the guild, was moved by Sir Richard Gregory. Special reference was made to the report presented by the Education Committee on "Industrial Research and the Supply of Trained Scientific Workers," which has been sent to the Prime Minister, the Minister of Education, and other authorities concerned. Shortly after its issue a deputation of representatives of British universities was received by the Chancellor of the Exchequer and the President of the Board of Education, who expressed sympathy with the plea for more generous State aid to the universities. The Civil Service Estimates for 1919–20, since published, show that 1,000,000*l*. is allotted to the maintenance of university institutions, as compared with 500,000*l*. for the year 1913–14. It is felt, however, that a full inquiry into the provision of university and higher technical education in this country is still needed.

Another subject that has received attention from a committee of the guild is the organisation of research in relation to fisheries. The report emphasises the importance to a maritime nation of investigations of the sea and development of its fishing resources. The work of existing bodies in this field deserves fuller support, and the establishment of an Advisory Council or Board of Marine Research is suggested. Especially it is urged that there should be a properly equipped institute and museum of oceanography in this country similar in scope to those existing in France, Germany, and now being planned in Denmark. A memorandum on the Decimal Coinage Bill is presented by the Metric System Committee, while the Technical Optics Committee has urged upon the President of the Board of Trade the necessity of establishing a strong optical industry in this country.

Simultaneously with the adoption of the annual report, the election of Major-Gen. the Right Hon. J. E. B. Seely, Admiral Sir David Beatty, Field-Marshal Sir Douglas Haig, and the Right Hon. the Lord Mayor of London as vice-presidents of the guild was announced. Major-Gen. Seely, in addressing the meeting, expressed his appreciation of this honour and his sympathy with the aims of the guild in regard to higher technical education and research, illustrating from his experience the important part played by the latter both in the war and in relation to industry. He referred particularly to aviation, a field in which progress was absolutely dependent on science—a fact repeatedly illustrated in the war and in the recent Atlantic flights. Of great importance was the perfecting of a system by which an aviator could at any moment ascertain his whereabouts or determine when he was flying upside down. He believed within a few years wireless telephony would go far towards the solution of the first of these problems.

An address was then delivered by the president, Lord Sydenham, on "Science and Labour Unrest." Such unrest, he remarked, was largely due to the revolution in industry brought about by the introduction of tools and machinery and the subsequent tendency, still proceeding, towards larger undertakings. In this process the intimate and friendly relation formerly prevailing between master and man had been partially lost. Moreover, the introduction of scientific methods of reproduction rendered work repetitive and monotonous, so that the personal skill of the craftsman to-day was, in general, inferior to that he possessed in the pre-machinery age. Science, however, which was responsible for these causes of unrest, could also remove them by providing for the worker better conditions of living; and among the pressing problems of this nature housing was one of the most important. Science had also shown that unduly long hours meant diminution of output, and research was now being made into the best means of eliminating industrial fatigue. Lord Sydenham also referred to various economic fallacies current among workmen, which found a congenial soil in the present unrest. Fuller education in economic subjects was necessary in order that these errors might be corrected.

Sir J. J. Thomson, who followed, referred to the many developments in applied science which had taken place during the war, and expressed the hope that the manipulative skill and aptitude for research developed in various special industries or for purposes of war would be preserved and utilised in the future in peaceful pursuits. He also emphasised the vital importance of scientific knowledge to officers in the Army and Navy, and especially to the General Staff—a matter which had been much neglected in the past. Similarly we should not make the progress we ought to make until the boards of public companies and the Government Departments included men imbued with scientific method, which he believed could be evolved only by scientific training. Sir J. J. Thomson also referred to the changes which were being made in the conditions of examination for the public service, whereby scientific subjects would be placed in a better position. He did not, however, mean to imply that the selection of men for appointments involving scientific knowledge should rest only on the results of examination. At the present time an opportunity offered itself of selecting men whose record showed ability in some field of science, and it was suggested that advantage should be taken of it.

In conclusion, a vote of thanks to the Wardens of the Goldsmiths' Hall was moved by Lord Avebury and seconded by Col. Sir John Young, who referred to the loss which the guild had sustained in the recent death of Sir Boverton Redwood, who had taken a keen interest in its work for many years, and was a past master of the Goldsmiths' Company. A vote of thanks to the chairman and speakers, moved by Major Sir Ernest H. Shackleton, was adopted by acclamation.

IMPERIAL EDUCATION CONFERENCE.

By invitation of the Chief of the Imperial General Staff, the universities, together with various institutions concerned with technical, commercial, and agricultural education, sent representatives to a conference held at Australia House on June 11 and 12 for the purpose of discussing problems which have presented themselves to the War Office in connection with the working of the educational schemes within the British Army and the Forces of the Dominions. Sir Henry Wilson described Lord Gorell's work as an effort to weave education into the life of soldiers, to make use of all special knowledge and skill possessed by enlisted men, and to hand back the soldiers on their return to civil life better citizens than they would have been but for their experience in the Army.

Mr. Fisher, President of the Board of Education, said that the great war from which we are just issuing has been, in a sense never before equalled, a war of science. Marvellous discoveries have been made in connection with aerial warfare, warfare against German submarines and German gas, but the most surprising invention of all was the invention of education in the Army. It was an invention scarcely second in importance to the invention of fire-arms. Referring to the calling together for the first time of young men from every Dominion overseas and the inclusion of many of them after the war in the home universities, he said that he would like every Englishman who went to the Dominions, and every member of our Dominions who settled in any other part of the Empire, to feel that his children would have the best educational opportunities that the Empire could afford. He would like to see the most promising students, whatever might be their special aptitudes, able to migrate to the university, in which they could attain to the best opportunity of development in their particular subjects.

Interchange of students and the need for a greatly strengthened Universities Bureau were two subjects which largely occupied the attention of the conference. The directors of education for the several overseas Forces emphasised the great need which they had experienced of a central office at which they could obtain information regarding the regulations, the activities, and the *personnel* of the various universities. Their demand for closer centralisation and uniformity of procedure led to a good deal of friendly banter. The diversity of the British universities, Sir Donald MacAlister pointed out, is their glory. They are able in an exceptional degree to adapt themselves to local conditions, to seize opportunity, and to make experiment. He contrasted them in this respect with the universities of France, from a visit to which, as one of the guests of the French Republic, he had just returned. All the speakers, however, agreed that co-operation amongst the universities is greatly to be desired. As Sir William Ashley put it, "the more they become dependent upon State support, the more desirable will it be that they should take counsel together."

The functions which might be undertaken by the Universities Bureau, if it were adequately staffed and endowed with funds, were defined by many speakers. President Tory would have it an office from which he could obtain information about men suitable for employment by the universities overseas. Prof. Ramsay Muir desired that it should undertake very great responsibilities in connection with the universities of India—work which no Government Department could perform to the complete satisfaction of our Indian fellow-subjects, because the Government must always be suspected of an ulterior aim, whereas the Universities Bureau would be managed by a federation, of which the Indian universities themselves would form a part.

Sir Henry Hadow, who presided over the session of Thursday morning, emphasised the importance of encouraging a free interchange of students for research work, and especially of young teachers. If migration is to be made popular and successful, the university laboratories will need to be well equipped, especially on the technological side. Technological courses should be widened and made to include as much general mental training as can be introduced into the curriculum. Mr. A. P. M. Fleming, speaking on behalf of the Federation of British Industries, urged that heads of departments are needed who are well educated in a general as well as in a technical sense. For many years to come the demand for men capable of undertaking research will greatly exceed the supply.

Lord Bledisloe at the afternoon session described agriculture as the industry most dependent upon science, and at the same time the most backward in recognising its obligation. He announced that the Board of Agriculture is prepared to participate in organising in London an Imperial Bureau of Agricultural Information. Dr. J. W. Robertson, ex-Principal of Macdonald College in the McGill University, described the successful working of "illustration" farms. The conference closed by adopting a resolution proposed by Sir Percy Fitzpatrick:—"That there is a general desire throughout the Empire that means shall be found to give practical effect to the policy, aspirations, and suggestions expressed during the four sittings of the Conference, and, in order that this may come about, the conference requests the Imperial Education Committee to submit to the Prime Minister of the United Kingdom a report of its proceedings, with a request that it be brought to the notice of all the Prime Ministers of the Empire, either at the Imperial Conference, or in such other manner as may be deemed appropriate to ensure early and practical results."

THE ROYAL OBSERVATORY, GREENWICH.

The report of the Astronomer Royal of the work done at the Royal Observatory during the year ended on May 10 was presented to the Board of Visitors on Saturday, June 14. Some of the details of the report are here summarised.

One of the two Chief Assistants, Mr. Jones, who had been engaged in optical work at Woolwich for nearly three years, resumed his duties at the observatory soon after the armistice Mr. Jackson, the other Chief Assistant, five members of the permanent staff, and eleven temporary computers who have been serving with the armies abroad in various capacities, returned to the observatory on different dates since February 1. With so many members of the staff absent it is not surprising that the work of the observatory has had to be curtailed in several ways, and the number of transits recorded with the transit-circle during the year was 3224, of circle observations 2818, which figures may be compared with an annual average number of 12,000 before the war. The sun, moon, planets, and fundamental stars have been observed on the meridian throughout, but other stars only to a limited extent. The observations of the moon with the transit-circle and with the altazimuth show that the increase of the error of the moon's place in the "Nautical Almanac," which has persisted since 1883, when Newcomb's empirical correction to Hansen's tables was introduced into the "Almanac," has now ceased, for the mean correction to the tabular right ascension, +0·92s., shown by the observations in 1918, is practically identical with that found in 1916 and 1917. The corresponding correction required by the "Connaissance de Temps," which depends on Delaunay's tables as revised by Radau and Andoyer, is +0·28s.

The observations with the Cookson floating zenith-telescope have been carried on throughout the war, and the result of a discussion of seven years' observations with the instrument was presented to the Royal Astronomical Society on June 13. Besides a determination of the variation of latitude at Greenwich, which may be considered trustworthy, as the discordances from a smooth curve rarely exceed a few hundredths of a second of arc, the observations also furnish a value of the aberration constant, which, deduced from the seven years' observations, is 20·442″, corresponding to a solar parallax of 8·815″. The values derived from the observations of individual years show rather a large range, and the possibility of systematic disturbing causes is being investigated.

Turning to the equatorials, the 28-in. refractor was at the disposal of M. Jonckheere until he returned to his home in Lille in January last. The observations of double-stars made by M. Jonckheere have been published in the *Astronomical Journal*. The object-glass of the 26-in. refractor, which had been dismounted in September, 1917, was replaced on October 15, 1918, and photographs of the Galilean satellites of Jupiter were taken on twenty-six nights during the apparition of last winter for Dr. de Sitter, who is making a research on the elements of their orbits. Photographs for stellar parallax have also been taken with this instrument. The 13-in. object-glass of the astrographic telescope is now in Brazil, having been used in observation of the eclipse of May 29. With this instrument a series of photographs were taken of the nova which appeared in Aquila in June, 1918, to determine its variation of magnitude in the subsequent months. The work of the Astrographic Catalogue is being supplemented by determination of the proper motions of the stars contained in it by comparison with earlier catalogues, and also by direct comparison of pairs of plates taken at an interval of about twenty years.

The record of the sun-spots has been continued, and photographs of the sun were obtained on 208 days. The measurement and reduction of the sun photographs for 1917, the series being completed by photographs taken at the Cape, is in progress. During the period covered by the report the activity of the sun has been considerable, but there has been, on the whole, a perceptible decline since the great disturbances of August, 1917.

The mean values of the magnetic elements for 1918 and three previous years are as follows:—

	Dec. W. ° ′	Horizontal force	Vertical force	Dip ° ′
1915 ...	14 56·5	0·18508	0·43315	66 51·8
1916 ...	14 46·9	0·18494	0·43313	66 52·7
1917 ...	14 37·0	0·18477	0·43305	66 53·6
1918 ...	14 27·2	0·18462	0·43290	66 54·2

The annual diminution of declination increased considerably about 1910, its average value from 1900–10 being 4·9′. The horizontal force which had been increasing since measurements were begun at Greenwich in 1846 reached a maximum about 1910, and is now diminishing. The dip which had been diminishing since measurements were begun in 1843 reached a minimum about 1913, and is now increasing.

The principal meteorological features reported for the year ended April 30, 1919, are:—The mean temperature was 49·5°, or 0·1° below the average of the seventy-five years 1841–1915. The highest temperature in the shade was 89·8° on August 22, and the temperature exceeded 80° on six days. The lowest temperature was 15·5° on February 9, and on fifty-five days it fell as low as 32°.

The duration of bright sunshine registered was 1436 hours out of a possible 4456 hours. The rainfall was 31·14 in., or 6·90 in. above the average for the period 1841–1915. The number of rainy days (0·005 in. or more) was 194, the largest number for thirty-six years; 7·34 in. of rain fell in July, 1918.

The work of rating and issuing the chronometers for use of the Navy has been excessive. During the year 8631 chronometers and watches were received and 6713 issued. The number sent for repair was 2990. The corresponding figures in the report of 1914 were 2094, 2110, and 934 respectively. The wooden time-ball on the observatory is to be replaced by one of aluminium, and the work is now in progress.

The report ends with a reference to the system of time-zones for time-keeping at sea, which the Lords of the Admiralty have decided to establish in H.M. Navy; also to the substitution of a day beginning at 0h. midnight for the astronomical day in all nautical publications. The Admiralty has decided that the alteration shall be made in the "Nautical Almanac" beginning in the year 1925, and in the "Admiralty "Tide-Tables" for 1920.

THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES.

THE twenty-fourth annual congress of the South-Eastern Union of Scientific Societies was held in the Guildhall, London, on June 11–14, under the presidency of Dr. A. Smith Woodward. In his opening address the president referred especially to the pioneer work of Mantell in discovering the fossil giant reptiles in the Sussex Weald, and showed how the later finds in Belgium and North America had partly modified, partly extended, his conclusions. He mentioned that Mr. Reginald W. Hooley had recently found in the southern cliffs of the Isle of Wight a skeleton of an iguanodon which rivalled those from Bernissart, Belgium, in perfection. The specimen showed a finely granulated skin. The sudden ending of the "geological age of reptiles," as Mantell named it, still awaited explanation, for the distribution of the giant reptiles was almost world-wide at the time. The mammals found the land practically vacant for occupation, and none of them attained a larger size than a tapir until the Middle Eocene period.

Mr. L. W. Chubb described the woodlands of London, and showed the importance of the work of the Commons and Footpaths Preservation Society. The congress passed a resolution urging the London County Council to secure Castle Wood on Shooter's Hill, Woolwich, as a public resort. Dr. A. B. Rendle, in an address to the botanical section, referred to the facilities for research at the South London Botanical Institute, which was founded by the late Mr. A. O. Hume. It was important to compare the British flora in detail with that of the European continent, and much remained to be done in studying growth-stages. Mr. C. C. Fagg reported on progress with the regional survey, and showed several maps on which he had plotted records in the neighbourhood of Croydon. Mr. Reginald A. Smith exhibited a map of London on which he had marked the finds of Palæolithic implements in their relation to the river-terraces. The Rev. T. W. Oswald-Hicks showed a series of lantern-slides illustrating the life of mosquitoes, which he had prepared, to be lent to the societies of the union. In this way he hoped to spread an interest in the subject and enlist the help of more observers and collectors of mosquitoes. Mrs. Plomer Young mentioned that several thousand lantern-slides illustrating natural history were now at the disposal of the union, and could be borrowed by the constituent societies. Sir Edward W. Brabrook was elected president of next year's congress, which is to be held at Eastbourne.

THE TEXTURE OF SANDS.

ALTHOUGH chemical analyses of sands have frequently been made for industrial purposes, and mineral analyses are now a feature of geological investigations into the petrology of sediments, comparatively little attention has been paid to the mechanical composition. This is particularly the case in the matter of the inter-relation of the mechanical composition with either the chemical or mineral constitution.

The connection between the mineral and chemical compositions of sediments is clear, the minerals representing the particular manner of grouping of the chemical elements. The relation of the mechanical composition to either the chemical or mineral constitution opens up a big field for future work, equally of considerable geological interest and immediate industrial application.

Sediments can be graded, according as they are coarse or fine, by screening or by elutriation in currents of air or water. The latter method has almost entirely replaced the older and less scientific one of subsidence. If screening is to retain any pretensions to accuracy, it cannot be carried out with sieves of less than 0·25 mm. aperture. On the other hand, elutriation of material more than 0·4 mm. in diameter is difficult to control on account of the eddies set up by the high velocities of the water-currents (47 mm. or more per second). In the mechanical analyses of sediments the two methods of procedure may be successfully combined, material more than 0·25 mm. in diameter being sifted, and that 0·25 mm. in diameter or less being separated into grades by elutriation in water. (Whilst elutriation by air-currents has been adopted commercially for grading the products of fine grinding, such as cement, silica-flour, barytes, etc., it cannot be considered sufficiently accurate for scientific work.)

It is regrettable that no general agreement exists as to the grades into which sediments should be separated. Soil analysts have adopted a series which, for certain cogent reasons, has not commended itself to those geologists who have worked at the problem. Another and different set of grades has been adopted by the potters in the separation of clays. The fact that comparatively few tables of mechanical analyses have yet been published is the strongest possible argument for agreement without delay upon a definite set of grades.

Such a division of sediments into grades is necessarily artificial. Nevertheless, the grades adopted by the geologists have as their basis the natural characteristics of the material so-named as observed "in the field." The grading system frequently adopted is:— >2 mm. diameter, gravel (G); >1 mm. and <2 mm., very coarse sand (VCS); >0·5 mm. and <1 mm., coarse sand (CS); >0·25 mm. and <0·5 mm., medium sand (MS); >0·1 mm. and <0·25 mm., fine sand (FS); >0·05 mm. and <0·1 mm., coarse silt or superfine sand (cs); >0·01 mm. and <0·05 mm., fine silt (fs); and <0·01 mm. diameter, clay or mud (c). It is a matter of controversy as to how far material of diameter less than 0·01 mm. may be accurately separated. Both elutriation and subsidence methods of separation can be arranged, but the testing of the accuracy of the process by actual measurement presents difficulties. A separation has, however, frequently been effected by subsidence methods supposedly accurate at the point 0·005 mm. diameter.

The grade sizes chosen are not of such great moment if graphical representation of the sediments by means of curves is adopted. For example, in Fig. 1, the method of plotting cumulative percentage weights against grade size is utilised. To keep the diagram within reasonable compass, the grade sizes are plotted horizontally at distances proportional to their logarithms. The ordinates at the grade size represent for each curve the percentage weight of material greater than that grade size. It is obvious that if a particular sediment be subjected to mechanical analysis upon a basis of grade sizes different from the above, the results should yield the same curve.

In the strict geological sense, the expression "sand" is a grade term, and is limited to material ranging from not less than 0·05 mm. to not more than 2 mm. in diameter. A perfectly graded sand would be one consisting of grains each with the same mean diameter. Such a sand has never been found naturally, but the ideal is closely approached by certain dune-sands which have been exposed to the transporting action of wind and water so frequently that grains smaller or greater than the average have been respectively carried ahead or left behind.

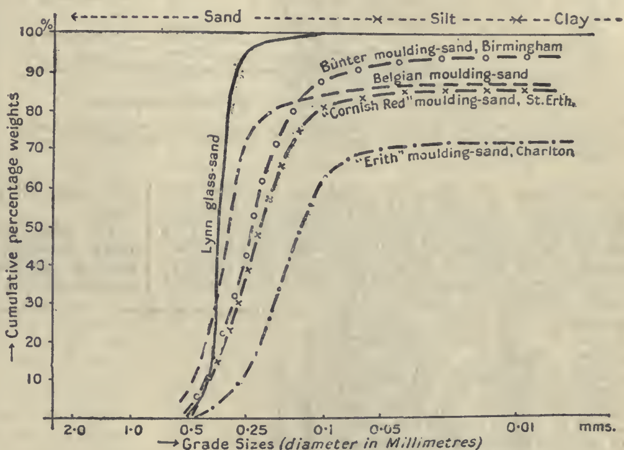

FIG. 1.—Mechanical composition of sands: graphical representation.

The term "sand" in the commercial sense, however, is used for sedimentary material of varying grades (as, for example, moulding sands), or even for the unclassified products resulting from the crushing of hard siliceous rocks, etc.

The texture of sands used in the casting of metals and alloys (particularly, perhaps, of steel, where the conditions are the most exacting) is of considerable industrial importance, as well as of scientific interest. When samples of the sands which have proved most successful for steel moulding are subjected to mechanical analysis, it is found that each consists of a high percentage by weight of the sand grade, a relatively large proportion of the clay grade, but little or no silt or superfine sand grade. Graphically expressed, the mechanical composition of such sands, of which "Belgian yellow" and "Cornish red" are

apposite examples, is shown in Fig. 1. The sand grade consists preferably of coarse or medium sand, the Belgian material being therein more suitable than that from Cornwall (St. Erth). Verticality of the graph over the region of the sand grade marks the preponderance of this grade, and horizontality over the region of the fine sand and silt grades indicates the relatively subsidiary character of the latter. This peculiarity in grading of moulding sands may be interpreted in the light of their behaviour in the foundry. A maximum pore-space would be yielded by a rounded sand uniform in grade. The presence of coarse, rounded grains in the sands mentioned above, therefore, permits the escape of the gases and vapours produced when the hot metal enters the mould. In short, the mould is said to be well "vented." If silt and fine sand were present in any considerable quantity, this natural venting would be gravely impaired. The clay grade is required to act as the "bond" uniting the sand grains together. Both the Cornish and Belgian sands mentioned have a strong bond—that is, contain a relatively high proportion of true clayey material (14 to 20 per cent.). The ideal condition in which the clayey bond exercises a maximum effect is that of a pellicle, as thin as possible, completely enveloping each quartz grain.

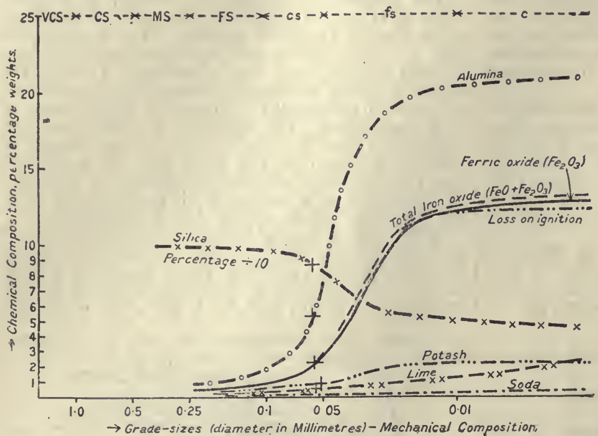

FIG. 2.—"Cornish red" sand for steel moulding: graphical representation of variation of chemical composition with grade. The large crosses + indicate the chemical composition of a "bulk" sample before elutriation.

In contradistinction to such peculiarly graded sands (for they are abnormal geologically, and hence are of restricted occurrence) are the well-graded materials desirable for glass manufacture. A sand such as that from near King's Lynn (Fig. 1), which contains a high percentage of grains belonging to the medium sand grade and practically no silt or clay, passes freely and evenly into melt, thereby assisting to produce a homogeneous glass as rapidly as possible.

The inter-relation of chemical and mechanical constitution is well brought out in moulding sands of good quality like those from St. Erth, Cornwall, and Fontenay aux Roses, near Paris (Figs. 2 and 3). Not only must the sand be composed of suitable grades; it must also be highly refractory to heat, and capable, for example, of withstanding the effects of molten steel run from converters and electric furnaces. ("Open-hearth" steel is not so exacting upon the sand.) The refractoriness to heat is indicated by the fact that chemical analysis of the coarse, medium, or fine sand grades shows them to be high silica sands containing only small proportions of alkalis and alkaline earths.

The variation of chemical composition with grade is expressed graphically in Figs. 2 and 3, where the high silica content of the sand grades is evident. Analysis of the clay grade shows that its composition closely resembles that of many first-class British fireclays, which are also very refractory. In addition, the diagram illustrates the presence of a relatively high percentage of hydrated ferric oxide; this compound is probably present in a colloidal form, and is responsible for much of the wonderful strength of the bond of the moulding sand.

The widespread American practice, now of many years' standing, of milling together a naturally occurring siliceous sand with a good fireclay and a certain amount of an artificial bond, such as dextrin, flour, molasses, etc., is in this connection very significant. It yields an indication of the manner in which the absence of the remarkable naturally bonded sands of Western Europe has been compensated by the production of an artificial mixture of somewhat

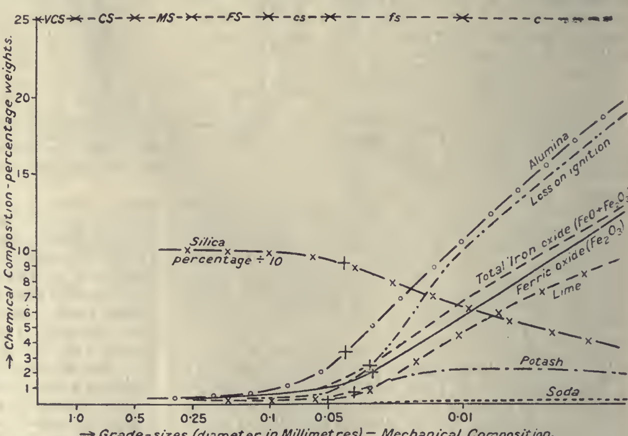

FIG. 3.—"French red" sand for steel moulding: graphical representation of variation of chemical composition with grade. The large crosses + indicate the chemical composition of a "bulk" sample before elutriation.

similar chemical and mechanical constitution, the resemblance having unwittingly been evolved.

Similarly, the study of the variation with grade in the mineral constitution of a sand presents results of great interest. The detrital minerals occurring in each grade vary in proportion, species, and physical characters. Generally speaking, the percentage weight of the heavy detrital minerals in any grade varies inversely with the grade size.

P. G. H. B.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held on April 24–26, and a programme of more than fifty papers covering a wide range of subjects was presented. The sessions were presided over by the president, Prof. W. B. Scott, and by Vice-Presidents G. E. Hale, H. L. Carson, and A. A. Noyes.

Two important features were a symposium on the solar eclipse of June 8, 1918, and one on chemical warfare. In the former, special attention was given to photographs and their interpretation of the prominences and the coronal arches and streamers obtained by members of the several expeditions sent from the Lick, the Mount Wilson, the Lowell, the Sproul, and the Yerkes Observatories. Several conspicuous prominences were shown, and these were generally surrounded by complex coronal structures. These coronal arches or "hoods" are probably among the most notable and remarkable photographed to date. They point to an intimate relation between the prominences and the surrounding coronal structure. From the comparison of the observations of earlier eclipses made at different epochs of solar activity, it seems probable that complex coronal detail and disturbed regions of the corona around the prominences are more pronounced near sun-spot maxima.

The symposium on chemical warfare was impressive as indicating the enormous quantities of poisonous gases, phosgene, mustard, and chloropicrin, made by the United States and shipped to Europe. Col. M. T. Bogert, who was in charge of the General Chemical Warfare Service, gave a brief historical introduction. He was followed by Col. F. M. Dorsey, who spoke on "Chemical Warfare and Manufacturing Development"; while Col. W. H. Walker gave an address on the production of chemical warfare munitions. Col. Bradley Dewey treated in detail the American means of defence against the deadly gases used in war, and told how more than five million gas-masks were made in eight months and sent overseas with nearly three million canisters for holding the absorbing chemicals, and how these chemicals were obtained, one item being four hundred tons a day of coconut-shells and peach-stones for producing the charcoal necessary.

A paper on "Detection of Submarines" by Dr. H. C. Hayes, who was stationed at the Naval Experimental Station at New London, discussed various possible methods. The most effective one resulted from the development of a system of multiple sound-sensitive receivers mounted in such a way as to transmit to both ears of the observer a cumulative or summational impulse which becomes a maximum when the instrument is properly directed, thus showing the direction of the submarine. It is clear that such an instrument would be valuable in peace-time also in indicating the presence and direction of vessels in a fog.

Col. Augustus Trowbridge, recently attached to Gen. Pershing's staff, and in charge of the Sound-ranging Service of the A.E.F., analysed the work of this Service, the success of which was remarkable. The location of active enemy batteries and of the direction of fire of friendly guns by means of sound is new, while that by visual means—flash ranging—is an outgrowth and extension of standard artillery methods.

A sound-ranging section was in the field with the first American Division, March, 1918, while on the date of the armistice the *entire front* of the 2nd American Army was covered by both flash- and sound-ranging sections. The "central" or calculating station, situated generally in a dug-out or ruined house, was more elaborate than in the case of the flash because of the greater instrumental installation of the sound-ranging section. The "central" instrument recorded photographically the time of arrival of the sound of enemy guns at a series of instruments at surveyed positions near the front line and covering a length of about five miles. This instrument delivered automatically developed and fixed photographic records in less than a minute after the sound of the enemy gun reached the front line, and this record could be interpreted by the use of quick graphical methods, so that the position of the enemy gun could be telephoned to the friendly artillery in about a minute more. The probable accuracy of the location could be given, and also the calibre and target of the piece which had just fired. The service was not interfered with by rain or fog or darkness, though it was rendered less accurate by strong winds. Calculations were rendered difficult by great artillery activity, though not impossible except under actual "barrage" conditions.

In ranging the friendly artillery on enemy objectives it was possible to range all the guns of the battery simultaneously, thus effecting considerable time-saving over other methods of ranging. If the ranging was being done on an enemy battery which had just fired, the accuracy attained was very great (less than twenty-five yards) because of the fact that in this case no wind or temperature corrections need be applied in the calculations.

A popular lecture, followed by a reception, was given on the Friday evening by Prof. Arthur G. Webster on "Recent Applications of Physics in Warfare."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Col. C. S. Myers and Lieut. H. W. Phear have been elected fellows of Gonville and Caius College.

MANCHESTER.—Mr. W. L Bragg has been appointed to the Langworthy chair of physics in the University of Manchester in succession to Sir Ernest Rutherford.

Prof. D. H. Macgregor has been appointed to the Stanley Jevons chair of economics in succession to Prof. S. J. Chapman, and Prof. O. T. Jones to the chair of geology in succession to Sir T. H. Holland.

OXFORD.—The statute for the reform of Responsions, which lately passed Congregation, came on June 17 before a well-attended meeting of Convocation. After speeches in favour of the statute by Mr. E. Barker, fellow of New College, and Mr. C. Norwood, Headmaster of Marlborough, and against it by Mr. E. Walker, fellow of Queen's, and the Regius professor of Greek (Prof. Gilbert Murray), a division was taken, from which there appeared 306 for the statute and 312 against it. The chief resident opponents of the statute have, however, pledged themselves not to resist a proposal by Prof. Gilbert Murray to introduce a statute on the earliest opportunity which will provide for the exemption from compulsory Greek

of men seeking honours in natural science or mathematics.

In the same Convocation the honorary degree of D.C.L. was conferred on Charles William Dyson Perrins, to whose liberality is due the fine new chemical laboratory in South Parks Road.

The gift of 25,000*l.* for the encouragement of the study of modern languages from Sir Heath Harrison, of Brasenose College, was gratefully accepted. The proceeds of this sum will be expended, partly on the provision of instruction within the University, and partly on the institution of travelling scholarships.

SHEFFIELD.—Sir Henry Hadow, Principal of Armstrong College, Newcastle-on-Tyne, has been appointed Vice-Chancellor of the University.

SIR JAMES CAMPBELL, Lord Chancellor of Ireland, has been appointed Vice-Chancellor of Dublin University, in succession to Archbishop Bernard, who has become Provost of Trinity College.

APPLICATIONS are invited by the Senate of the University of London for the filling of the newly instituted chair of aeronautics tenable at the East London College. The latest time for receiving applications is the first post of Monday, July 7.

THE Salters' Institute of Industrial Chemistry has awarded four more fellowships for post-graduate study in the laboratories indicated:—Capt. W. H. Hoffert and Capt. A. G. Pollard (Rothamsted Experimental Station), Mr. L. A. Ravald (Municipal Technical College, Manchester), and Mr. M. L. Wilson (The University, Manchester).

WE learn from *Science* that Queen's University, Kingston, Ontario, has received an additional endowment of 200,000*l.* for the general purposes of the University. It is proposed to secure several more full-time professors and to develop the departments of physiology, bacteriology, and public health. A fund of 40,000*l.* is also available to be expended in the reconstruction of the hospital.

THE tenth British Esperanto Congress was held in Liverpool during the Whitsun week-end, and more than five hundred Esperantists were present. The congress was opened by Mr. James G. Legge, Director of Education in Liverpool, who gave the congressists a warm welcome, and expressed his sympathy with the aims of Esperanto. The annual general meeting of the British Esperanto Association was held during the congress, and many speakers commented on the recent progress made and on the suitability of the present time for a vigorous propaganda. The social functions of the congress were of a very varied nature. Two concerts were given, Esperanto being almost exclusively used for songs and recitations. The public was admitted to one of these concerts, and between the musical items demonstrations were given with the help of foreign Esperantists who were present. A visit was paid to the University of Liverpool, where the congressists were addressed by the Vice-Chancellor, Sir Alfred Dale, who afterwards showed the party some of the interesting features of the University. Parties of more than two hundred Esperantists also visited the Port Sunlight works of Lever Brothers and one of the Atlantic liners at the docks. The organising committee of the congress is to be congratulated on the excellence of their arrangements, and it was generally agreed that the congress was the most successful and enjoyable that has yet been held by British Esperantists.

A CHART prepared by Principal J. C. M. Garnett, College of Technology, Manchester, shows what the youth of the country should be receiving in the way of education between the ages of ten and twenty-five years, and indicates also their probable occupation in life. The diagram includes all grades of education, from the elementary schools (public, and private preparatory) to the universities and to post-graduate work, and includes also full-time and part-time courses, both general and special. The system is one "proposed to be brought into operation in England during the decade ending ten years hence," and it is, therefore, not very obvious why 30 per cent. of the youth should be shown as having no further school education after leaving the part-time secondary school at the age of eighteen. There is also no provision shown for general cultural education, such, for example, as that given so successfully in the Danish "People's High Schools," unless something of the kind is to be inferred from the footnote: "Junior and senior technical courses do not mean narrow vocational courses, but a general education which has a centre of interest in some group of occupations, into one of which the pupil is expected to enter." Why not, however, provide a general education for persons eighteen years of age and upwards which shall have a centre of interest in life itself rather than in any group of occupations? In Denmark, "of the 79 Government accredited schools, 48 adhere to the culture idea, pure and simple; and in this list are, perhaps, a majority of the schools which have done most to place a real stamp on the character of the nation" (H. Foght in "Rural Denmark and its Schools").

AN address on science and education recently delivered by Prof. J. Graham Kerr before the Royal Philosophical Society of Glasgow includes an earnest plea for the inclusion of science in any scheme for the complete and efficient education of the citizen. By science is meant, not merely the acquisition of book knowledge or that it be taught *ex cathedra*, but the patient, accurate, and direct investigation of phenomena in order that the pupil may attain a first-hand knowledge based upon individual experience of the processes of Nature, and with the ultimate purpose of "the training and development of the powers with which Nature has endowed him so as to give him the highest possible degree of competence for successfully tackling the problem of the life which lies beyond the school or college." The address is thoroughly democratic in its aim, and Prof. Kerr would so order our system of education as to bring its facilities within reach of the poorest of the community where ability merits aid and encouragement. In his view it is essential to enlightened popular government that the mass of the people should enjoy the advantages of a sound education, and that science in its fundamental aspects be continuously taught throughout the school and college career. He is of opinion that the subject of physics lends itself admirably in the early stages of training, since its phenomena are simple and demand, through repeated measurements, complete accuracy, and, along with mathematics, he would inseparably link with it a training in the use of the English language. Prof. Kerr further discusses the conditions under which a stable modern society can subsist and progress, and demands that biological science should find a place in the training of the future citizen, so that he may grasp the principles which underlie the problems of communal life. He further advocates the establishment of free popular lectures on science.

THE Journal of the British Science Guild for April contains a report by the Education Committee of the guild on "Industrial Research and the Supply of Trained Scientific Workers." Data are presented contrasting the facilities for research and sums expended on technical education in this country with those in the

United States and in Germany. In the United States there are 10 students at universities and technical institutions per 10,000 of population, in Germany 14, and in the United Kingdom only 6; Scotland, however, is more favourably situated, the value being 17. According to Sir J. J. Thomson's committee, the total annual output of first and second class honours men in science and engineering from all the universities in this country is little more than 500. The number of men students entering universities and colleges of England and Wales during 1913–14 was about 4400, about half this number being from public schools. Of youths leaving public schools about 25–30 per cent. pass on to universities; of boys leaving State-aided schools at ages over sixteen years, probably only 10 per cent. Whereas the income from endowments of the eighteen State-aided universities and colleges of England and Wales amounts to about 100,000*l.*, a third of the income being from Parliamentary grants, the total gifts and endowments of universities and colleges in the United States in a single year, 1913–14 (excluding grants from States, the Federal Government, or municipalities) was equivalent to an income exceeding 200,000*l.* The bequests to universities and colleges in the United Kingdom in the same year amounted to, roughly, 5 per cent. of the American endowments, *i.e.* to about the same value as the income derived. The Journal also contains the report of the organising committee of the British Scientific Products Exhibition and a list of donors. The success of the 1918 exhibition is regarded as of hopeful augury for the corresponding exhibition arranged to take place this year.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, June 4.—Mr. G. W. Lamplugh, president, in the chair.—Dr. A. S. **Woodward**: The dentition of the Petalodont shark, Climaxodus. The author describes the nearly complete dentition of a new species of Climaxodus from the Calciferous Sandstone of Calderside, near East Kilbride (Lanarkshire), now in the Royal Scottish Museum, Edinburgh. Climaxodus and Janassa are shown to be two distinct genera. These Petalodonts are especially noteworthy among the Elasmobranchii, because during the greater part of the life of each individual there cannot have been more than six or eight teeth in succession, a condition remarkably different from that in all ordinary sharks and skates, in which the successional teeth are always very numerous and rapidly replaced. The same limited tooth-succession is to be observed in the Carboniferous Cochliodontidæ, and perhaps also in the contemporaneous Psammodontidæ.—F. **Debenham**: A new theory of transportation by ice: the raised marine muds of South Victoria Land (Antarctica). A series of deposits of marine muds are found on the surface of floating "land-ice" in the deep bays of Ross Sea (Antarctica). Similar deposits are also found on land up to a height of 200 ft., in some cases on old ice, in other cases on moraine. The deposits are briefly described, and former theories concerning them are discussed. A new theory is put forward, prefaced by an account of the nature of the typical ice-sheet which bears them. The upper surface of the sheet is known to suffer a net annual decrease, and evidence is given to show that the lower surface has a net increase by freezing from below. The theory is that the sheet will freeze to the bottom in severe seasons, and enclose portions of the sea-floor. Owing to the method of growth of the sheet by increments from below, the enclosed portions will ultimately appear on the surface, thus being raised vertically as well as translated horizontally.

Linnean Society, June 5.—Dr. A. Smith Woodward, president, in the chair.—H. N. **Dixon**: Mosses from Deception Island. The mosses were collected on Deception Island, South Shetlands, by Mr. James C. Robins. Deception Island is in lat. 63° S., long. 60° 30′ W., closely adjoining the Antarctic continent (Graham Land). It has been very little visited, and until the present century only two plants—an unnamed moss and a lichen—had been observed. Two mosses were collected there in the second French Antarctic Expedition (1908–10) by MM. Gain and Gourdon. The present collection consists of eight species, one known from most of the colder regions of the world, one hitherto recorded only from the South Orkneys, three of general Antarctic distribution, two hitherto known only from the Antarctic continent, and one new species. The interior of the island is a vast crater, into which the sea has irrupted, and is about five miles across. Connected with this is a small lagoon, some 500 yards in diameter; Mr. Robins describes it as giving no bottom at 200 fathoms, and as fed by warm or hot springs from the volcano. The whole crater would seem, in the middle of extreme glacial surroundings, to afford an almost unique example of an isolated biological area, and would appear to deserve a careful survey as regards its fauna and flora, especially in so far as concerns that of the warm springs and the lagoon fed by these.—Miss Alwen M. **Evans**: The structure and occurrence of maxillulæ in the orders of insects. This paper embodies the results of the author's investigation into the structure and distribution amongst insect orders of those vestigial mouth-parts which Hansen (1903) homologised with the maxillulæ of Crustacea. In it is included, as completely as space will allow, what has hitherto been written as to the presence and form of these structures of the Insecta, since Hansen's theory was put forward.—E. E. **Unwin**: Notes upon the reproduction of *Asellus aquaticus*. The intimate relationship between the moulting of the cuticle and the reproductive processes is clearly shown, and the details of the marriage-clasp, copulation, release of the oostegites, egg-laying, and fertilisation are described. The appendages associated with these operations are also described. The aeration of the eggs in the brood-pouch is effected by a periodic movement of the oostegites and by the flapping action of the maxillipedes. The eggs are prevented from escaping at the anterior end of the pouch by the position and movement of the first pair of legs, and by a special coxal lobe carried by the maxillipedes.

PARIS.

Academy of Sciences, May 26.—M. Léon Guignard in the chair.—G. **Bigourdan**: The observatory of the Hôtel de Cluny, afterwards the Nautical Observatory.—H. **Douvillé**: Concerning a memoir of J. de Lapparent on the breccias of the neighbourhood of Hendaye.—P. **Termier** and G. **Friedel**: The *débris* of strata, or "Klippes," of the Alais plain; fragments of mylonitic Urgonian limestone placed on the Oligocene.—H. **de Chardonnet**: An application of the eight-hour day. An account of the successful introduction of the eight-hour day in Hungary in the artificial silk industry. The machines are run continuously, women taking two shifts during the day, and men the shift from 10 p.m. to 6 a.m.—L. E. J. **Brouwer**: The invariant points of the topological transformations of surfaces.—F. **Vlès**: Remarks on the serial constitution of absorption spectra. Several absorption spectra can be represented by the relation

$$\lambda = \lambda_0 + An + Bn^2 + Cn^3,$$

where n is an integer. Examples are given for the absorption spectra of potassium permanganate,

hæmoglobins, chlorophyll, and neodymium chloride.—A. **Colson**: Reduction of cryoscopy to the general laws of solubility.—A. **Noyes**: The counter e.m.f. of polarisation in sulphuric acid. The counter e.m.f. of a solution of sulphuric acid at first diminishes with the temperature, proportionally to the reciprocal of the absolute temperature. From 60° to 120° C. the fall is more rapid, and above 120° it scarcely varies at all. The change may be attributed to a difference in the mode of ionisation.—G. **Langlois**: A new synthesis of benzylidene-acetone. Cinnamene is condensed with acetyl chloride in presence of diethylaniline. The product was characterised as benzylidene-acetone by its oxidation products, formation of dibromide and semicarbazone, and by elementary analysis.—J. **Guyot** and L. J. **Simon**: The action of heat on the methylsulphates of the alkalis and alkaline earths. At 220°–280° C. sodium and potassium methylsulphates give methyl ether and a pyrosulphate, some methylsulphate being formed as a by-product. With barium and calcium methylsulphates methyl sulphate is the main product of the reaction, with minimal proportions of methyl ether.—P. **Pelseneer**: Production of hybrids in molluscs.—L. **Roule**: The first phases of embryonic development in *Palemon serratus*. Criticism of a recent communication to the *Comptes rendus* by M. E. Sollaud on the development of *Leander-Palemon squilla*.—C. **Vaney** and A. **Allemand-Martin**: The action of *Hippospongia equina* of the coasts of Tunis on the Posidonia.—H. **Coutière**: The morphology of the limb of the Crustacea.—E. **Fernández-Galiano**: The conjunctive tissue of the heart of the snail.—C. **Gessard**: An achromogenic variety of the pyocyanic bacillus. This new type gives pyocyanine on glycerine gelose-peptone, but gives no pigment when cultivated in aqueous peptone. M. **Ménard** and C. **Delval**: The action of the X-rays on fibro-myomas of the uterus in woman.—A. **Robin**: The hydration, soluble residue, and insoluble residue in cancer of the liver. A new theory on the genesis of cancer.

BOOKS RECEIVED.

An Introduction to the Study of Science. By W. P. Smith and E. G. Jewett. Pp. xi+620. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

The Foundations of Geography in the Twentieth Century. By F. Schrader. (Herbertson Memorial Lecture, 1919.) Pp. 26. (Oxford: At the Clarendon Press.) 2*s*. 6*d*. net.

The Analysis of Minerals and Ores of the Rarer Elements. By Dr. W. R. Schoeller and A. R. Powell. Pp. x+239. (London: C. Griffin and Co., Ltd.) 16*s*. net.

A Handbook of Medical Jurisprudence and Toxicology. By Dr. A. Brend. Pp. xiii+317. (London: C. Griffin and Co., Ltd.) 10*s*. 6*d*. net.

An Arithmetic for Preparatory Schools, with Answers. By T. Dennis. Second edition. Pp. xiv+376. (London: G. Bell and Sons, Ltd.) 4*s*. 6*d*.

Differential Calculus for Colleges and Secondary Schools. By Dr. C. Davison. Pp. viii+309. (London: G. Bell and Sons, Ltd.) 6*s*.

DIARY OF SOCIETIES.

THURSDAY, JUNE 19.

INSTITUTION OF MINING ENGINEERS, at 11.—Lt.-Col. D. Dale Logan: (*a*) The Difficulties and Dangers of Mine-rescue Work on the Western Front. and Mining Operations carried out by Men wearing Rescue-apparatus; (*b*) Accidents due to Structural Defects of Apparatus or Injury to Apparatus. and the Future of the Proto Apparatus.—M. W. Blyth and L. T. O'Shea: The Examination of Coal in Relation to Coal-washing.—Prof. F. W. Hardwick: Reply to the Discussion on his Paper on the Training of Students in Coal-mining, with Special Reference to the Scheme of the Engineering Training Organisation.—W. Maurice: The Education of Colliery Managers for Administrative and Social Responsibilities.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture. Hon. R. J. Strutt: A Study of the Line Spectrum of Sodium as Excited by Fluorescence.

LINNEAN SOCIETY, at 5.—T. A. Dymes: Notes on the Life-history of the Yellow Flag. *Iris pseudacorus*, Linn., with Special Reference to the Seeds and Seedlings during their First Year.—Dr. G. H. Rodman: Egg-case of a Spider from the South of France—*Cyrtarachne tuberculifera*.—S. L. Moore: A Contribution to the Flora of Australia.—A. W. Waters: Observations on Certain Species of Bryozoa, chiefly belonging to the Selenariadæ, Conescharellinidæ, etc.—Dr. E. Penard: Studies on some Flagellata.—Dr. W. M. Tattersall: Report on the Stomatopoda and Macrurous Decapoda Collected by Mr. Cyril Crossland in the Sudanese Red Sea.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—W. H. Goodchild: The Genesis of Igneous Ore Deposits.

CHEMICAL SOCIETY, at 8.

WEDNESDAY, JUNE 25.

GEOLOGICAL SOCIETY, at 5.30.—A. E. Kitson: Outlines of the Geology of Southern Nigeria (British West Africa), with Especial Reference to the Tertiary Deposits.—Prof. J. B. Harrison and C. B. W. Anderson: Notes on the Extraneous Minerals in the Coral-Limestones of Barbados.

THURSDAY, JUNE 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Dr. A. E. H. Tutton: Monoclinic Double Selenates of the Cobalt Group.—Bertha Ayrton: A New Method of Driving off Poisonous Gases.—Dr. F. W. Aston: Experiments with Perforated Electrodes on the Nature of the Discharge in Gases at Low Pressure.—Mary Seegar and Prof. Karl Pearson: De Saint-Venant Solution for the Flexure of Cantilevers of Cross-section in the Form of Complete and Curtate Circular Sectors; and on the Influence of the Manner of Fixing the Built-in End of the Cantilever on its Deflection.—Dr. H. Jeffreys: The Relation between Wind and the Distribution of Pressure.

FRIDAY, JUNE 27.

PHYSICAL SOCIETY, at 5.—Prof. C. L. Fortescue: The Current-Voltage Characteristics of High-Voltage Thermionic Rectifiers.—Prof. Ernest Wilson: The Measurement of Small Susceptibilities by a Portable Instrument.

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THURSDAY, JUNE 26, 1919.

FOREST POLICY AND LAW IN THE UNITED STATES.

(1) *The Development of Forest Law in America: A Historical Presentation of the Successive Enactments, by the Legislatures of the Forty-eight States of the American Union and by the Federal Congress, Directed to the Conservation and Administration of Forest Resources.* By J. P. Kinney. Pp. xviii+254+xxi. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 11*s*. 6*d*. net.

(2) *The Essentials of American Timber Law.* By J. P. Kinney. Pp. xix+279+x. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 13*s*. 6*d*. net.

(1) BEFORE the coming of European settlers the forests of the United States occupied an enormous area, half the whole country being covered with trees. This vast heritage has been greatly diminished. In the east there was little or no open land for the settlers, and clearings had to be made for farms and villages. Forest fires, felling for timber, and grazing have also shared largely in the destruction of a great part of the original forest. The history of the movement, so far as it is expressed in legal enactments, by which a check has been put on the wasteful exploitation of the great natural resources of timber is well given in the volume entitled "The Development of Forest Law in America."

Contrary to general belief, the Colonial legislatures in early days passed many laws against the destruction of forests by fires, and made enactments prohibiting waste of timber on common lands by unnecessary or indiscreet cutting. In 1818 a Massachusetts Act authorised agricultural societies to offer premiums to encourage the growth of oak and other trees necessary for shipbuilding; and, soon after, many States imposed severe penalties for the offences of cutting timber or setting fires on public lands. The first effective steps, however, in conservation were taken in 1885, when the New York legislature established a permanent forest administration and created forest reserves in the Adirondack and Catskill Mountains. The administration was specially charged with the duties of prevention and control of forest fires and with the encouragement of forestry on private lands.

In 1881 a Federal Act was passed which authorised the President to create "forest reservations in any State or Territory having public lands, wholly or in part covered with timber or undergrowth, whether of commercial value or not." It was high time, as sixty years had passed since the last preceding Act contemplating a general reservation of lands for the purpose of conservation of timber. "During this long period the pineries of the Northern States, which had seemed inexhaustible in 1831, had largely disappeared; the future exhaustion of the timber supply of the Southern States had become apparent to the far-sighted, and the transference of the title from the Federal Government to private individuals and corporations of vast areas of the incomparable forests of the Pacific Coast region had been effected." The Government began to take strong measures. President Harrison immediately set aside 17,000,000 acres of forest reserves out of the public lands which had not been distributed to settlers. Influenced by the ideas of Gifford Pinchot, who became chief of the Division of Forestry at Washington in 1898, virile Presidents like Cleveland and Roosevelt increased year by year the forest reserves until they amounted in 1905 to 100,000,000 acres. The name "national reserves" was changed to "national forests" in 1907. Besides the national forests, set aside out of public lands in the west, which now cover 170,000,000 acres, there are mountain forests in the east, in the Appalachian and White Mountains, which are being gradually purchased under the provisions of an Act passed in 1911 that authorised the expenditure of 11,000,000 dollars in their acquisition.

In addition many of the States have State forests, New York owning, for example, 1,800,000 acres, and Pennsylvania 400,000 acres. Nearly 300,000 acres of forests, owned by various cities and towns, have been acquired with the object of protecting the urban water supplies from contamination by impurities, which are always present when water catchment areas are subject to farming or grazing. In many of the States planting is encouraged by the distribution of young trees to private persons at low rates, and in other States bounties for planting are given—in Kansas, for example, 10 dollars per acre planted. In New York plantations of trees of from 1 to 100 acres are exempt from all taxation for a period of thirty-five years. The book under review is replete with information of this kind, showing the various ways in which forestry is encouraged in the United States by Government action.

(2) This is a compact treatise dealing with the statutes concerning property in trees, forests, and forest products in the United States, and with the interpretation of the laws by the courts. The first two chapters define and classify property and ownership in general. The next chapter treats of trees and timber as property. The legal doctrine of waste, timber trespass, and contracts referring to timber are each the subject of three chapters. Inspection and measurement of timber products are treated in twelve pages, and the laws referring to transport of timber by water in thirty pages. Mortgage on timber; the laws of boundary and highway trees; trees, nurseries, and sawmills as fixtures, are each the subject of a separate chapter. The final pages discuss the free use of timber taken from public lands by settlers and by mining, telegraph, and railway companies.

These two text-books on forest law by Mr. J. P. Kinney form an important contribution to the rapidly growing mass of American forestry lierature, and impress one with the painstaking way in which authorities and cases have been cited.

INORGANIC AND PHYSICAL CHEMISTRY.

(1) *Recent Discoveries in Inorganic Chemistry.* By J. Hart-Smith. Pp. x+91. (Cambridge: At the University Press, 1919.) Price 4*s.* 6*d.* net.

(2) *Recent Advances in Physical and Inorganic Chemistry.* By Dr. Alfred W. Stewart. With an introduction by Sir William Ramsay. Third edition. Pp. xv+284. (London: Longmans, Green, and Co., 1919.) Price 12*s.* 6*d.* net.

(3) *Osmotic Pressure.* By Prof. Alexander Findlay. Second edition. (Monographs on Inorganic and Physical Chemistry.) Pp. xi+116. (London: Longmans, Green, and Co., 1919.) Price 6*s.* net.

(1) "RECENT Discoveries in Inorganic Chemistry" is a summary of facts culled from the literature of inorganic chemistry during the last fifteen years or so. "The book is in no sense intended to be a text-book, but is rather to be regarded as a supplement to existing text-books." Regarded from this point of view, the little volume fulfils its object. It will serve, at any rate, to indicate many of the more important subjects of recent inorganic research, although the account given of each is in general so brief that the original work and the collateral literature will have to be consulted. As the book stands, the title is rather too comprehensive.

(2) This book, which has now reached its third edition, consists of twenty chapters, eight of which are devoted to inorganic problems, four to radio-activity, and six to physical chemistry. It is written in a very clear and lucid style, and is eminently readable. Arbitrariness in the choice of the material discussed is almost inevitable in a book of this size. Thus whilst we find an excellent account of such subjects as radio-activity, X-rays and crystal structure, atomic numbers, and analysis by means of positive rays, we do not find any consideration of the modern advances made in chemical thermo-dynamics (such as the Nernst heat theorem), nor an account of the quantum theory, photo-chemistry, colloids, the work of Perrin and of Millikan on the determination of the Avogadro constant, the work of Langmuir on surface action, and the modern views of allotropy. Perhaps the least satisfactory chapter is that which deals with the structure of the atom. The subject is admittedly difficult to treat, but the author is scarcely justified in devoting a single paragraph to the Rutherford-Bohr atom, whilst giving a page to the purely geometrical atom model of G. N. Lewis, and five pages to his own atom, from which no quantitative results have as yet been obtained. Further, the gibe at the school of Ostwald in chap. xx., and the reference to the "thirty years of relative stagnation" from which physical chemistry is supposed to have suffered, are singularly inappropriate. As a matter of fact, the portions of the book which deal with inorganic chemistry and radio-activity are very much more satisfactory than the treatment of physical chemistry.

(3) Prof. Findlay's monograph on osmotic pressure is already so well known that it is only necessary to direct attention to the fact that a second and enlarged edition has now appeared. After dealing with the problems of the experimental measurements of osmotic pressure for both dilute and concentrated solutions, Prof. Findlay goes on to discuss in some detail the significance of the results obtained. This develops into a most illuminating account of the theory of solutions, involving a consideration of the allied properties, vapour pressure, lowering of freezing-point, and rise of boiling-point. Stress is rightly laid upon the necessity for distinguishing between the thermo-dynamic significance of osmotic pressure and the various attempts which have been made to picture the mechanism on a molecular basis. An equally clear distinction is drawn between osmotic pressure itself, the phenomenon of osmosis, and the mechanism of permeability of the membrane. The monograph is indispensable to every physical chemist.

W. C. McC. Lewis.

THE PRIMITIVE NERVOUS SYSTEM.

The Elementary Nervous System. By Prof. G. H. Parker. (Monographs on Experimental Biology.) Pp. 229. (Philadelphia and London: J. B. Lippincott Co., 1919.) Price 2.50 dollars net.

RECENT research on the functions of the nervous system of man and other mammals, such as Head's clinical observations and Sherrington's experimental work, has revealed the fact, which had not been adequately recognised before, that many of the most archaic dispositions of the primitive nervous system have survived in the highest vertebrates, where, as a rule, they are disguised and hidden from view by the more obtrusive features that give the vertebrate nervous system its distinctive character.

The need for a fuller and more accurate knowledge of the nature and origin of the earliest nervous mechanisms has thus become more insistent and essential to everyone who is attempting to understand the working of any of the more complex types of nervous system.

For some years, and especially during the last ten, Prof. Parker, of Harvard, has been investigating the simpler types of neuro-muscular apparatus, and has published (mostly in journals that are not easily accessible) a series of memoirs dealing not merely with the structure, but also with the functions, of this system, making use of the exact methods of modern quantitative measurement to estimate and express the results of his experiments.

Those who have followed his researches, no less than those who are not acquainted with the illuminating results of his work, will heartily welcome this small volume (one of a new American series, inspired, as the editors tell us, by the series of British monographs on physiology and biochemistry), in which he has collected his scattered papers and woven their contents into a clearly co-ordinated and simple story.

The book deals mainly with the neuro-muscular system of "the three simpler phyla of the multicellular animals, the sponges, the cœlenterates, and the ctenophores," but some of the most illuminating passages in the work deal with the survival of such primitive mechanisms in the heart, the alimentary canal, and other parts of the higher vertebrates. This much-tilled field of research was well worth re-cultivating; and Prof. Parker has been able to clear away much of the uncertainty and confusion in the results obtained by earlier workers, and to bring to light many new points that had escaped notice before.

Although it must be obvious that the functions of the most primitive nervous system, as an instrument to quicken and direct the response to changes in the animal's environment, presuppose the existence of a muscular system to perform such quick and precise actions, it remained for Prof. Parker to discover that the differentiation of muscle did actually precede the appearance of a nervous system.

Another important feature of the book is the convincing series of ingenious experiments to clear up the difficulties of the problem of nervous transmission in sea-anemones.

Prof. Parker seems to adopt the tradition of the text-books of physiology for students that the most primitive type of nervous system is of the two-celled receptor-effector type—simply a specialised sensory cell put into connection with a neighbouring muscle either directly or through the intermediation of a nerve-cell. But it is difficult to conceive of the biological usefulness of such an arrangement of isolated neuro-muscular units; and, so far as I am aware, there is no evidence of its existence, except in conjunction with a system that links up the whole organism. As Prof. Parker himself has shown (pp. 94 and 95), stimulation of one spot (in an animal provided with the most primitive type of nervous system) excites a response of the whole animal, and not merely of a single muscle-fibre.

G. Elliot Smith.

OUR BOOKSHELF.

A Practical Handbook of British Birds. Edited by H. F. Witherby. Part i. Pp. xvi+64. (London: Witherby and Co., 1919.) Price 4*s.* net.

Ornithology, judged by its voluminous and ever-increasing literature, is to be regarded as one of the most attractive branches of natural science studied in the British Isles, and the works devoted to our native birds are amongst the most popular of all. The appearance of yet another book on British birds may be welcomed, since it brings our knowledge of the subject up to date. In recent years great changes have been made in the scientific nomenclature of ornithology, and, alas! are still in progress, while the recognition of numerous racial forms among the birds on the British list has rendered the study of the varied members of our avifauna difficult, especially for the field observer, and hence has given a great impetus to collecting. In addition to these major changes, important advances have been made in our knowledge of the many and complicated movements of migratory birds witnessed on our shores; and also the periods of moulting and other changes in plumage. All these come within the scope of the work under consideration.

The information under each species is divided into sections, and dealt with throughout in uniform order. These sections include keys to the various groups from orders to species, plumages, nesting, food, distribution, etc. While this method of treatment has its advantages in brevity, it detracts much from the literary aspect of the work, and renders it unattractive reading. Though the plan has been carefully carried out, the sections lack uniformity in treatment, inasmuch as those devoted to plumages are redundant as compared with the rest. The shorter the accounts of plumages the better, provided they are adequate, for unnecessary details are neither conducive to lucidity nor helpful. As regards the illustrations, the coloured plates (of which there are to be twelve) are good, and the text figures (which are numerous), though satisfactory on the whole, are in many cases poor, and in others unnecessary. It is a sign of the times that a handbook on British birds, professedly compact and concise, should run to 1200 pages. The work is to be issued at intervals in eighteen parts, and when complete will form two volumes.

Soils and Fertilisers. By Prof. T. L. Lyon. Pp. xxii+255. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 6*s.* 6*d.* net.

This little book is written chiefly for elementary students in secondary agricultural schools, for short-course students in colleges, and for teachers attending summer courses. A good deal of the material is drawn from the author's well-known larger work on soils, which was written for senior students. In spite of differences of conditions here and in the United States, the English teacher will find the book of interest as being a compact summary of the points which an American teacher brings before his students.

The first three chapters deal with soil formation, a subject which in this country is left to the geologist, the soil student taking the soil as he finds it and not concerning himself with its origin. Then follows a section on soil water, which in many parts of the States is of great practical importance, and in any case presents many features of scientific and educational interest.

The author distinguishes three forms of soil water: hygroscopic water, a thin film absorbed from the air and condensed on the particles of the dry soil; capillary water, also a film, but thicker than the preceding, taken up by soil in contact with liquid water and held by surface forces; and gravitational or free water, which can drain away, and, indeed, should be allowed to do so wherever it assumes unduly large proportions. No mention seems to be made of the mole plough, which, in this country, has proved of great value in drainage work. Afterwards comes a chapter on the bacteria of the soil, followed by one on soil air and soil temperature.

The remainder of the book deals with fertilisers. It is evident that American farmers suffered much less from shortage of fertilisers than did our own farmers as the result of the war. For, whilst an English book written, like the book before us, in 1918 would have been compelled to devote much space to substitutes and to revise considerably the descriptions of processes and comparative standards, the author did not find such alterations necessary, and his chapters differ little from what might have been written before the war.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Credibility of Long-continued Experiments.

AT the Rothamsted Experimental Station certain experiments are continued for a long series of years in order to amass sufficient data to allow of proper statistical treatment. Some of the experiments have been carried on since 1843, others since 1852, 1856, 1860, etc. A characteristic feature of the work is the length of time for which particular observers are responsible for their records, some being in charge of the same work for twenty, thirty, or forty years. The fundamental weakness in such long-continued experiments is one inherent in human nature itself: errors once introduced are apt to persist, and to cause much harm unless they are soon detected.

In many of the experiments it is not possible to institute any very satisfactory check on the results. In some cases, however, this can be done. The measurements taken at the rain and drain gauges afford an instance, and the agreement is so close as to deserve record.

In 1870 three drainage gauges and one rain gauge were set up at Rothamsted, each 1/1000 acre in area. The rain gauge is simply a very large funnel embedded in the soil; the drain gauges are also large funnels, but filled with soil to depths of 20, 40, and 60 in. respectively. In constructing them, however, the soil was not disturbed, but was left in its natural position, whilst the framework of the gauge, by an ingenious arrangement, was built round it. From 1870 to the present day readings have been taken of the amounts of water percolating through the drain gauges: this amount being some 40 to 60 per cent. of the water collecting in the rain-gauge. Samples of the water from each gauge are then sent to the laboratory, where the chlorine and nitric and ammoniacal nitrogen are determined.

This work went on without intermission from 1888 until 1916, when it was suspended owing to the sudden death of Dr. N. H. J. Miller, who had been in charge the whole of the time.

The results have now been calculated out and added up.

It is well established that soil neither absorbs nor gives up chlorine to water containing sodium chloride in solution, therefore the amounts of chlorine found in the drain gauges ought to be equal to that in the rain gauge if the numerous separate records were accurate. Over a short period there is always liable to be a difference, because some of the chlorine may not yet have had time to percolate, but over a long period this is eliminated. The actual results obtained at Rothamsted are:—

Chlorine in lb. per acre.

Average per annum for 4 years		From drain gauges 20 in.	40 in.	60 in.	From rain gauge
1882–92	...	12·24	13·27	12·45	12·25
1892–96	...	14·15	15·19	14·24	14·35
1896–1900	...	16·26	17·61	16·07	17·90
1900–04	...	17·67	18·65	17·79	17·23
1904–08	...	16·23	16·18	16·00	16·75
1908–12	...	19·57	18·86	20·67	18·48
1912–16	...	19·02	18·93	19·58	19·54
Total amounts for 28 years					
1888–1916	...	460·56	474·76	467·20	466·00

The number of measurements involved is very large; there are some 18,000 readings at the gauges and a large number of titrations in the laboratory. The gauge-reading has to be multiplied by its titration value, and the resulting figures are then added up. Considering the multiplicity of the data, the agreement in the results is remarkable; the widest divergence over twenty-eight years is only 2 per cent.

This close agreement is the result of careful daily work, and not of accident. There is no correspondence in the laboratory between the rain and the drainage samples; this is prevented by the carry-over of water and of chlorine in the drain-gauges from day to day, and even month to month. Nor is there any possibility of straining readings to compel agreement; the figures were not regularly added up during the course of the work, but only at rare intervals.

The result shows how accurately continuous observations can be made provided care is taken. The readings at the gauges have throughout been taken by Mr. E. Grey, who without fail and in all weathers has stuck to the work. The titrations were made by the late Dr. Miller, who would have felt great pride in the final result had he lived to see it. Fortunately, Mr. Grey is still in charge of the gauges.

E. J. RUSSELL.

Rothamsted Experimental Station, Harpenden.

The Lustre of Some Feathers of Humming Birds.

THE brilliantly metallic feathers of the crests and gorgets of most humming birds, which are also erectile, must have a great significance, and present an interesting problem. Why should the most intense brilliancy be on those particular spots?

An explanation suggested itself while observing a doctor examining the throat of his patient, in bright sunshine, by the help of a laryngoscope fixed upon his forehead, his patient being placed with his back to the light.

Holding a humming bird, in *bright* sunshine, in front of the corollæ of flowers that were turned away from the light, the illumination of the inside of the corolla was most striking, and its use in revealing any small insects it might contain became quite apparent.

The refulgent patches of feathers are absent in some groups of humming birds, such as the "Hermits," but these have the habit of frequenting the gloom of the forests, and of catching the small insects that form their food from on, or beneath, the foliage, and these habits explain their absence.

Perhaps this suggestion may lead others to investigate the facts from a more strictly scientific viewpoint. H. J. CHARBONNIER.

Rose Cottage, Olveston, nr. Bristol.

The Stinging Instinct in Bees and Wasps.

IT is almost impossible to irritate a worker wasp or bumble-bee to the pitch that it will fly to attack, except when it is defending its home. The queen wasp or bumble-bee will not even defend her home. If she is disturbed when the nest is in a very early stage, she deserts it. When it is in an advanced stage she will return to it afterwards. Worker honeybees are also disinclined to attack except when defending their home But in beating off a threatening bee as one walks through the apiary, one is very likely to get stung. The readiness to attack and the force of the attack are in proportion to the population of the colony. As soon as the nest or hive is removed, the returning bees or wasps that hover around the old place, vainly searching for it, cannot be induced to attack.

But recently I took a hive of bees out of its winter case and carried this case, which had a few of the bees crawling around the flight-holes, to a distant part of the apiary. Two hours later some of these bees still remained on the case, and I started to brush them off. They flew up angrily at me and gave me several stings. Hive-odour is evidently an important factor in the stimulation of the stinging instinct.

F. W. L. SLADEN.

Ottawa, Canada.

The American Astronomical Society.

SOME of your readers may have seen the erroneous statement in the issue of *Science* for May 9, 1919, p. 446, stating that at the next meeting of the American Astronomical Society there would be representatives from the observatories of Greenwich, Oxford, Cambridge, Vienna, and Potsdam. This statement was copied from a student publication, which confused the coming meeting with the attendance at previous meetings of the society. There will, of course, be no German or Austrian astronomers at any meeting of the society in the near future.

JOEL STEBBINS (Secretary).

Urbana, Illinois, June 11.

GRAIN PESTS AND THEIR INVESTIGATION.[1]

A CONSIDERABLE number of different insects and mites occur in flour and stored grain, some of which bring about serious damage, while others are of comparatively little economic importance. Up to the year 1917 very little had been done in this country with the view of determining the best methods for dealing with grain pests. No trustworthy estimates were available as to the actual damage sustained by cereal crops while in storage, although there is abundant evidence that material injury is incurred to both wheat and maize, either before or after its arrival in Britain. In June, 1916, the Council of the Royal Society, as the result of a correspondence with the Board of Agriculture, appointed the Grain Pests Committee for the purpose of investigating the relative importance of grain insects, suggesting measures for combating them, and inquiring into the extent of the losses sustained. The Committee included Mr. J. C. F. Fryer (Board of Agriculture), Mr. O. E. Robinson (representing the milling trade), with Prof. Herdman as chairman. Representatives of the Liverpool grain trade and of the Incorporated National Association of British and Irish Millers were also added. Direct relations with the trades concerned were established, and problems observed in the mills and warehouses were investigated both on the spot and in the laboratory. It was decided to divide the work between several institutions in London and the Liverpool University, while further work was delegated to the zoological laboratory at Oxford.

The results obtained by the Committee's investigations are being issued by the Royal Society in two series: (1) Memoranda mainly of a provisional nature; (2) reports of the detailed investigations. Three reports and the same number of memoranda have appeared up to date. The first report, by Prof. Dendy, deals with the effect of air-tight storage upon grain insects. The earlier belief that grain weevils are almost independent of ventilation, and can live indefinitely in tightly closed vessels, is not borne out by Prof. Dendy's experiments, in which hermetically sealed vessels were used. By enclosing *Calandra granaria* and *C. oryzae* in hermetically sealed vessels containing wheat, the carbon dioxide evolved was observed to have a lethal effect upon the imprisoned insects. It was found that within the limits of a wide range of conditions as to temperature, moisture, and degree of infestation hermetical sealing is a very effective method for dealing with the weevil problem. The time taken to bring about the lethal effects appears to depend chiefly upon the relative volume of air present. In practice it is, therefore, of first importance to ascertain that hermetical sealing of the silos or other receptacles is effectively carried out.

The greater part of the second report is by Prof. Newstead and Miss Duvall on the Acarids of stored grain and flour. The most important species concerned is *Aleurobius farinae*, which is not infrequently accompanied by the predaceous mite *Cheyletus eruditus*. An excellent account of the structure and bionomics of the latter species is given: the authors express doubt whether it is ever sufficiently abundant in Nature to be effective

[1] Royal Society, Grain Pests (War) Committee. Report No i., May, 1918. (1) Introductory Note. By the Chairman of the Committee. (2) Report on the Effect of Air-tight Storage upon Grain Insects. Part i. By Prof. A. Dendy. Report No. ii., 1918. (1) Bionomic, Morphological, and Economic Report on the Acarids of Stored Grain and Flour. By Prof. R. Newstead and H. Muriel Duvall. (2) Appendix i. By Prof. J. M. Beattie. (3) Appendix ii. By A. E. Humphries, Member of the Royal Commission on Wheat Supplies. Report No. iii., November, 1918. (1) Report on the Effect of Air-tight Storage upon Grain Insects. Part ii. By Prof. A. Dendy and H. D. Elkington. (2) Experiments with Two Secondary Grain Pests, showing their Inability to Attack Sound Wheat. By Prof. A. Dendy. (3) Observations on the Attraction of Certain Grain Beetles, especially Weevils, by Water. By Prof. A. Dendy. Memoranda Nos. i.-iii. Issued January 24, 1918.

in reducing Tyroglyphid pests. It is found that mites will not injure wheat and flour in which the moisture content is 11 per cent. or less, whatever the temperature may be. When the moisture exceeds 13 per cent. they increase and flourish exceedingly; given favourable moisture conditions, the mites increase very rapidly between 60° and 75° F., while between 40° and 50° F. increase is retarded. The remedy advised for mite-infested wheat is to screen it thoroughly in order to remove as many of the mites as possible, and to subject it to treatment whereby the moisture is reduced, such as a blast of hot air followed by cooling. Prevention from attack may be secured by storing flour with a low moisture content—below 11 per cent. The lowest lethal temperature for the mites was found to be 120° F., which required at least six hours' application to be effective. In the form of appendices to the report are observations by Prof. Beattie on the degeneration of flour caused by bacteria, and by Mr. A. E. Humphries on an examination of flour samples into which acari had been introduced.

In the third report Prof. Dendy, in conjunction with Mr. H. D. Elkington, records the effect of air-tight storage upon other grain insects. It is claimed that air-tight storage is probably the most effective method of preserving all grain and cereal products from any insect or mite attack. It is particularly satisfactory to note that this method was found to be successful in destroying the larvæ of the notorious Mediterranean flour moth (*Ephestia kühniella*), along with the various other species dealt with. At the end of the report Prof. Dendy gives an account of experiments which go a long way towards proving that the beetles *Tribolium castaneum* and *Silvanus surinamensis* are unable to attack sound wheat. It appears, therefore, that these pests are of a secondary nature, only attacking and completing the destruction of already damaged grain. In a third article Prof. Dendy records observations which confirm the general opinion that *Calandra oryzae* and *C. granaria* are powerfully attracted by moisture. When water is present in sufficient quantity, *C. oryzae* is the more strongly attracted species.

In the forthcoming reports we shall look forward to a presentation of the results of testing these important laboratory experiments on a large scale in mills, warehouses, and elsewhere. During these times of food scarcity and high prices it is urgent that opportunities for this work should be afforded as speedily as possible. Every saving in grain destruction, with the consequent economy in the use of shipping, contributes towards the early settling down of the country to more normal conditions. To avoid waste in every form should be a keynote of national reconstruction. The importance of storage in air-tight receptacles is widely recognised in India, although the factors involved have not been understood. The initial difficulties of constructing air-tight silos and receptacles need to be surmounted. Once this is achieved, as Prof. Dendy remarks, the method is likely to prove valuable where large quantities of grain have to be stored for lengthy periods, especially in hot climates or even during long sea voyages. Air-tight storage is likely to prove effective not only as a preventive measure, but also as a remedy against badly weevilled grain. Both the Committee and the investigators directly concerned are to be congratulated upon the experimental results so far achieved. Fundamental observations of this nature can scarcely fail to prove beneficial to the State.

A. D. IMMS.

THE JEWELRY TRADE IN WAR-TIME.[1]

"MINERAL INDUSTRY" is an annual publication which treats of the state of the trade of the various minerals entering into commercial use in the United States during the previous year. The volume for the year 1917 did not appear until the close of last year. As for so many years past, the chapter in it on precious stones comes from the pen of the well-known authority on all that is concerned with gem-craft, Dr. G. F. Kunz, of New York. With his customary happy touch he interweaves the statistics of imports with much that is of interest to the economist and the mineralogist.

We have remarked before on a similar occasion that the jewelry trade acts as a very sensitive barometer indicative of the general state of trade in a country. The unpreparedness of the Allied nations for war, and especially of our own country, had led to the placing of immense orders for munitions in the United States, and the consequent keen demand for labour brought sudden affluence to certain classes in the community. The result was that the imports of precious stones in 1916 reached unprecedented heights. By the following year the industrial position had become stabilised, and the imports stood at a figure—just under 41 million dollars—which was about that of the more prosperous years immediately preceding the war. It must, however, not be forgotten that prices had risen very considerably. Thus Dr. Kunz tells us that in Great Britain the cost of cut diamonds had advanced between 30 and 40 per cent., the increase being about equally divided between the rise in wages and the advance in the charge for the rough stones.

Many have remarked as a curious and unsatisfactory state of affairs that in the days before the war, whereas practically all the rough stones in the world passed through London, very few indeed of them were cut in England. A century ago things were different; then London vied with Amsterdam, but for some reason or other—possibly the want of a fostering hand—the industry pined and withered, and a few years ago had all but passed away. Under the stimulating care of Mr. Bernhard Oppenheim, efforts are now being made to restore the industry, and a very promising scheme, which has had the practical support of the powerful De Beers Company, is working at

[1] "The Production of Precious Stones for the Year 1917." By Dr. G. F. Kunz. "Mineral Industry," 1918, vol. xxvi., pp. 576–601.

Brighton for enabling men partially disabled in the war to be trained in the craft of cutting gem-stones, and especially diamonds.

Of what in the trade are known as fancy stones, the most popular during the year under review appear to have been sapphire and emerald. Ruby still remains under a cloud, probably owing to the competition of the synthetical product. The Burmese jade, which is worked by Chinese and Japanese artificers, has been in considerable demand. Gem-stones, on account of their hardness, find a use in industry. The diamond drill is a familiar instance, but it may not be so well known that some electric motors have jewelled bearings; one factory in the United States used for that purpose no less than a ton of sapphire material.

Among the new occurrences of gem-stones referred to by Dr. Kunz may be mentioned opal, with an emerald-green to apple-green play of colour, from Hôsaka, Japan; black opal from Stuarts Range Field, South Australia; and chrysolite from Lac La Hache, British Columbia, which has been found in ten-carat stones. Dr. Kunz makes no reference to the beautiful blue zircons from India, which form one of the most interesting novelties in London jewelry of recent years; but, perhaps owing to the interruption of the ordinary trade channels, these stones had not, at least in any quantity, reached New York.

NOTES.

ADDITIONAL interest has been given to the forthcoming commemoration of the centenary of the death of James Watt by the movement just inaugurated in Glasgow to found locally a James Watt chair of engineering at the University. Birmingham engineers decided some time ago that a similarly named chair should be installed in the University of their city, besides holding a centenary commemoration and erecting an international memorial to the three great pioneers, Watt, Boulton, and Murdock. The commemoration in Birmingham will be held on September 16–18. London, Glasgow, and Greenock, and, indeed, all parts of the country, are heartily co-operating, and, with few exceptions, the universities and scientific societies, together with many manufacturers and individual eminent men, are associating themselves with the scheme. In the Science Museum at South Kensington steps are being taken to arrange a comprehensive exhibition of Watt relics. In Birmingham the Watt relics existing there, which have so carefully been preserved by the forethought of Mr. George Tangye, and were a few years back presented to the city, will be completely re-arranged and displayed with many additions. Two pumping-engines made by Boulton and Watt will be seen; one, the first sold by the makers in 1776, will be actually shown under steam, and raising water. A memorial service will be held in the Parish Church at Handsworth, where the three contemporaries are buried. A garden-party will be held in the park at Heathfield Hall, where the garret workshop still remains as Watt left it. Lectures will be delivered by eminent men and a centenary dinner held. Some doubt seems to have been raised with regard to the claims of Birmingham to an international memorial. It should be remembered, however, that Watt's association with Boulton led to the success of his engine. Boulton's factory was famous for workmanship throughout Europe. It is true that Watt conceived his first ideas whilst working at the University in Glasgow, but he gained no practical success until he went to Birmingham. He spent the best part of his life there, including the evening of his days after he retired from business. The foundations he laid by scientific thought and careful study have resulted in the great and universal application of steam, and the appeal comes appropriately from Birmingham for an international memorial to him.

THE Wilbur Wright memorial lecture was given on June 18 at the Royal Society of Arts by Mr. Leonard Bairstow. The subject was "The Progress of Aviation in the War Period," and the lecture commenced with a *résumé* of the progress made during the last five years, and a discussion of the possibilities of the present-day aeroplane for commercial purposes. By far the most interesting part of the lecture was that dealing with stability. An account was given of the use of the accelerometer to record the acceleration of a machine during any manœuvre, and of the information which has been obtained from its readings. Only in rare cases is the acceleration such as to reduce the pilot's apparent weight to zero, and in the majority of "stunts" he is pressed into his seat by a force greater than his normal weight. Mr. Bairstow exhibited a gyroscopic model which clearly showed the nature of stable and unstable oscillations, and then showed some lantern-slides made from accelerometer records, in which these types of oscillation had been observed on actual aeroplanes. He strongly emphasised the necessity for a thorough investigation of all the problems connected with the stability of aeroplanes, and expressed a hope that, now the war is ended, systematic research will be put in hand to provide fundamental data which will enable the scientific designer to treat stability with the same degree of certainty as he is now able to compute the performance of a machine. Mr. Bairstow's opinions on this point are of great interest, as he was the first to apply the results of wind-tunnel experiments on models to the complete calculation of the stability of a machine.

AT the summer meeting of the Anatomical Society, held at the Royal College of Surgeons, London, on June 21, Major E. Distin Maddick exhibited a series of moving films which he had prepared to illustrate the application of the kinema to the teaching of anatomy. During the war Major Maddick designed and prepared many films for the use of cadets of the Royal Air Force, showing the building up and dismantling of aeroplanes and aeroplane engines. In these films the spectator saw the various machines taken to pieces and the parts again assembled, exhibited and built up at a rate suitable to permit a demonstrator to name the various parts and explain their uses. It was this method which Major Maddick, who is a member of the College of Surgeons, has applied to the teaching of anatomy. His films show a human skeleton which turns its various aspects to the audience and then begins slowly to disintegrate until only the spinal column is left. The parts then begin to assemble, and part by part the skeleton is again built up. For large audiences desirous of becoming acquainted with the elements of human anatomy Major Maddick's films will serve a most excellent purpose, and are certain of a welcome by our soldiers in France and on the Rhine. The members of the Anatomical Society, while admiring the excellence of the technique shown by Major Maddick's films, expressed the hope that he would extend its application,

particularly to the movements of limbs and joints in health as well as in disease. Such films would prove invaluable for investigators, teachers, and students.

AN International Hydrographic Conference was opened in London on June 24. The subjects to be discussed are:—(1) Charts; (2) sailing directions; (3) list of lights; (4) notice to mariners; (5) time-signals, distance-tables, and other miscellaneous hydrographic publications; (6) tide-tables; (7) instruments used for surveying on shore and at sea; (8) time-measuring instruments; (9) interchange of publications; and (10) establishment of an International Bureau. Representatives were present from Argentina, Belgium, Brazil, Chile, China, Denmark, Egypt, France, Great Britain, Greece, India, Italy, Japan, Netherlands, Norway, Peru, Portugal, Siam, Spain, Sweden, and the United States. Rear-Admiral Sir John Parry was elected president of the conference; M. Renaud, vice-president; and Mr. W. D. Barber, secretary.

PROF. F. SODDY has been elected a foreign member of the Swedish Academy of Sciences in succession to the late Sir William Crookes.

THE council of the British Scientific Instrument Research Association has appointed Mr. H. Moore to be assistant director of research.

MR. L. G. RADCLIFFE, of the Municipal College of Technology, Manchester, has been awarded the gold medal of the Worshipful Company of Dyers, London, for his researches on the sulphonation of fixed oils.

THE following acceptances of lectureships in connection with the Royal College of Physicians of London are announced:—Dr. J. L. Birley, the Goulstonian; Sir W. Leishman, the Horace Dobell; Sir J. Rose Bradford, the Lumleian; and, for 1921, Dr. J. L. Golla, the Croonian.

THE Ministry of Health for England and Wales has now been formally established by Order in Council, and the King has approved the appointment of Dr. Addison as the first Minister of Health. The functions and staff of the Local Government Board will be taken over by the Ministry.

THE annual general meeting of the Research Defence Society will be held at the rooms of the Medical Society of London, 11 Chandos Street, Cavendish Square, on Thursday, June 26, at 4.30, Lord Knutsford presiding. A short address will be given by Sir Anthony Bowlby on "Experimental Medicine and the Sick and Wounded in the War."

THERE will be an additional meeting of the Royal Astronomical Society this session, probably on July 11, to receive certain American astronomers who are on their way to Brussels to take part in the conference of the International Research Council, which will be opened there on July 18. The party is expected to include Profs. Adams, Boss, Campbell, Eichelberger, Mitchell, Schlesinger, and Stebbins.

THE last conference of the present series on "Health Work for Whitley Councils" will be held under the auspices of the Industrial Reconstruction Council on Tuesday, July 1, at 6 p.m., in the Hall of the Institute of Journalists, 2 and 4 Tudor Street, E.C.4. The chair will be taken by Sir Alexander Roger, and the opening address given by Dr. E. Halford Ross, after which will follow questions and discussion. No tickets are necessary.

THE death is announced, in his seventy-fifth year, of Dr. William Gilson Farlow, professor of cryptogamic botany at Harvard University since 1879. Dr. Farlow was president of the American Academy of Arts and Sciences in 1905. He was the author of books on "The Black Knot," "Diseases of Olive and Orange Trees," "The Gymnosporangia," "Marine Algæ of New England," "The Potato Rot," and an Index of Fungi.

A SUMMER meeting of the Royal Meteorological Society will be held at Kew Observatory, Richmond, on Wednesday, July 2. A demonstration of a portable wireless apparatus for use in the location of distant lightning flashes will be given by Mr. R. A. Watson-Watt, and the president (Sir Napier Shaw) will exhibit two diagrams showing the motion of air in travelling depressions. Pilot-balloon ascents will be made from the observatory grounds, and there will be an exhibition of autographic records of the observatory, photographs of clouds and other meteorological phenomena, and recent meteorological instruments.

THE President of the Board of Agriculture and Fisheries has appointed a Departmental Committee to arrange for the testing, adaptation, and improvement of machines likely to prove of value to agriculture, to examine inventions and new devices, and to advise as to the further steps which should be taken to promote the development of agricultural machinery. The Committee consists of the following members:—Sir Douglas Newton (chairman), Mr. G. C. Baddon, Mr. Thompson Close, Major J. G. Merrison, Capt. B. J. Owen, Mr. H. G. Richardson, Prof. R. S. Seton, and Mr. J. G. Stewart. The secretary of the Committee is Mr. V. E. Wilkins, Board of Agriculture, 72 Victoria Street, London, S.W.1, to whom all communications should be addressed.

As already announced in NATURE (February 6, 1919, p. 448), a revision of "Pritzel's Index" is in course of preparation by the Royal Horticultural Society, with the assistance of botanists attached to the Royal Botanic Gardens, Kew, the Natural History Museum, the Linnean Society, and the co-operation of the U.S. Government Plant Bureau. The estimated cost of the production of the work is 3500*l.*, which may possibly be increased to 4000*l.* in consequence of the present enhanced cost of labour and materials. Up to the present contributions amounting to 968*l.* have been promised, but, being of the opinion that many more people would like to have a share in the issue of this important work, an appeal for subscriptions has just been circulated by the Royal Horticultural Society, Vincent Square, S.W.1.

THERE has been formed in America a Union of Scientific Federal Employees similar to the National Union of Scientific Workers in this country. The aims of both unions, to advance science as an essential element in the national life by improving the status of the scientific worker, are stated in terms which are nearly identical. The American union differs from the British; first, because it includes only Federal employees, and, secondly, because it is affiliated to a "Labour" organisation. The first difference already seems likely to disappear; the second indicates a difference in political conditions rather than in policy, for one of the chief arguments urged in America for affiliation was based on the cordial relations of the Labour unions to the Federal Departments. Another argument, which has also been urged over here, is that intimate relations with scientific workers will widen the outlook of the Labour unions. There is no indication at present how the American union proposes to solve the difficult problems connected with qualifications; perhaps they do not arise while membership is restricted to Federal employees. The secretary of the union is P. G. Agnew, Bureau of Standards.

Regulations have been drafted by the Society of Engineers for association with other engineering societies. The scheme admits members of such associated societies to various privileges offered by the Society of Engineers, such as attendance at meetings, visits, functions, etc., the use of the library and reading-room, and also of the appointments and employment register. The society contributes to the associated society not more than one-fifth of the annual subscription paid to the society by each member thereof who is also a member of the associated society at the date of his election. Provision is also made for the representation of associated bodies at meetings of the council of the Society of Engineers, but it is stipulated that the latter does not assume responsibility for any acts done or liabilities incurred by any associated society. It is stated that the Gloucestershire Engineering Society was the first to be associated with the scheme.

The inaugural meeting of the American Society of Mammalogists was held in the New National Museum, Washington, D.C., on April 3 and 4. Officers were elected as follows:—*President:* C. Hart Merriam, Smithsonian Institution. *Vice-Presidents:* E. W. Nelson, U.S. Biological Survey, and Wilfred H. Osgood, Field Museum of Natural History. *Recording Secretary:* H. H. Lane, University of Oklahoma. *Corresponding Secretary:* Hartley H. T. Jackson, U.S. Biological Survey. *Treasurer:* Walter P. Taylor, U.S. Biological Survey. With the intention of aiding research and of centralising ideas and energy, committees were appointed on the life-histories of mammals, the study of game mammals, anatomy and phylogeny, and bibliography. The policy of the society will be to devote itself to the study of mammals in a broad way, including life-histories, habits, relations to plants and animals, evolution, palæontology, anatomy, and other phases. The publication of the *Journal of Mammalogy*, in which popular as well as technical matter will be presented, will begin this year. Membership in the society is not confined to Americans, but any person interested in mammals is invited to join. Application for membership may be sent to Mr. Hartley H. T. Jackson, U.S. Department of Agriculture, Washington, D.C.

The drought which has been so severely felt over the southern portion of England came to an end on June 20, when there was an inch of rain over the metropolitan area due to the passage of a secondary disturbance. In many parts of the country, especially in the north and west, there was a break in the drought on June 12 due to the passage of a well-developed cyclonic disturbance across the country. Over London generally the weather was absolutely rainless for 25 days from May 10 to June 3 inclusive, and for Kew Observatory the Daily Weather Report gives no measurable rain for 32 days from May 3 to June 3. For a period of 48 days from May 3 to June 19 the total rainfall at Kew was only 0·08 in.; a partial drought, more than 28 days the aggregate rainfall of which does not exceed 0·01 in. per diem, continued for 51 days, from April 30 to June 19, the total rain measurement being 0·43 in. At Greenwich the drought lasted only 15 days, from May 10–24; whilst at Portland the drought continued for 32 days from May 18 to June 18. At Dungeness, for a period of 46 days from May 4 to June 19, the rainfall was only 0·14 in., whilst a partial drought continued for 50 days from May 4 to June 22, and was continuing at the time of our going to press. The rainfall for the seven weeks, May 1 to June 18, varied much in different parts of the country. At Stornoway the measurement was 5·50 in., at Glasgow 4·75 in., and at Birr Castle, Ireland, 5·65 in. At the English stations the Meteorological Office returns show that the rainfall was very much less. The amounts were:—Liverpool, 1·82 in.; Nottingham, 1·63 in.; Yarmouth, 1·32 in.; Jersey, 0·85 in.; Portland, 0·64 in.; and Dungeness, 0·34 in.; whilst for the London area the Rainfall Organisation at Camden Square had 0·48 in., Greenwich Observatory 0·45 in., and Kew Observatory 0·19 in. The absolute drought was severe and prolonged, but the partial drought was of comparatively short duration compared with others in the spring of former years.

The Government of the Punjab has recently announced that three great irrigation schemes, each costing 1000 lakhs of rupees, are now under consideration. They are expected to yield a financial return of from 6 to 8 per cent. on the capital expenditure. These projects are: A canal starting from the Indus at Kalabagh to irrigate 5,000,000 acres, or 8000 square miles, of wilderness lying between the Indus, Jhelum, and Chinab rivers; the Bhakra reservoir dam, 350 ft. high, to be built across the Sutlej at the debouchure from the Himalayas in order to store up 110,000 cubic ft. of water for purposes of irrigation during the winter; and the Sutlej valley project of canals from the Sutlej near Ferozepore for irrigation chiefly of the territories of Bikaner and Bahawalpur.

The Moriori, who inhabited the Chatham Islands, and are now practically extinct, have excited an interest comparable in kind, though not in degree, with that aroused by the extinct Tasmanians. They have until quite recently been regarded as a branch of the Maori people driven to the Chathams many generations ago by tribal war. But this view has been challenged on linguistic and other grounds, among which are differences between the Maori and Moriori vessels. The latter are carefully described by Mr. H. D. Skinner in the May issue of *Man*. Mr. Skinner's conclusion is that "the Moriori Waka-rimu may very well have combined elements derived from raft and canoe, a development necessitated by the absence at Chatham Islands of any timber from which a dug-out canoe could be made. . . . The use of rowing, as opposed to paddling, for the propulsion of canoes has been recorded amongst the Maoris on the west coast of the South Island, while an oar of the Moriori type was found many years ago in a cave at the head-waters of the Taieri in Otago, and is now in the Otago University Museum."

The *Veterinary Review* for May (vol. iii., No. 2) contains a valuable bibliography on contagious abortion of cattle. It starts from the year 1895, and contains 225 references. The remainder of the issue is occupied with abstracts, bibliography on current literature of veterinary subjects, and book reviews.

Capt. Major Greenwood discusses problems of industrial organisation in a paper published in the March issue of the Journal of the Royal Statistical Society (vol. lxxxii., part ii.). The advantage in respect of retention of workers of the factory with a welfare system appears to be considerable. As regards the influence of the type of work, the younger women doing heavy work do not seem to fall away faster than those of a similar age doing light work, but with women above twenty-two years of age there is a decided difference. Contrasting day-workers and continuous night-workers, the percentage inferiority in output of the night-workers amounted to $17 \pm 4{\cdot}1$ in winter and 12 ± 3 in summer. As regards hours of

labour and output, a reduction of $8\frac{1}{2}$ hours per week (from 68·2 hours to 59·7 hours) increased the gross output by 8 per cent.

FROM an analysis of more than half a million admissions to sick report of troops in camps in the United States, of whom 531,445 were white and 15,186 coloured, Lt.-Col. A. G. Love and Major C. B. Davenport form a comparison of white and coloured troops in respect to incidence of disease. As regards total relative frequency of disease in the two races, the coloured troops were about 19 per cent. more liable to go on sick report than the white troops. The coloured troops were relatively less resistant to diseases of the lungs and pleura as well as to certain general diseases, like tuberculosis and smallpox; they are also much more frequently infected with venereal diseases. But the uninfected negro is highly resistant to diseases of the skin, mouth, and throat; he seems to have more stable nerves, has better eyes, and metabolises better (Proc. National Acad. Sciences, vol. v., p. 58, 1919).

DR. H. H. LAUGHLIN has made a cytological and statistical study (Carnegie Inst. Washington, Publication No 265, pp. 48+18 tables) of the relative and absolute durations of the several arbitrarily delimited progress-stages in cell-division. His material was found in the root-tip cells of the common onion. With great carefulness Dr. Laughlin has determined the duration of ten successive stages at temperatures of 10° C., 20° C., and 30° C. The total period at these three temperatures was 292·52, 240·97, and 91·56 minutes respectively. The resting stage counts for 194·92, 159·57, and 33·26 minutes; the early prophase for 52·2550, 59·2592, and 51·4147. Thereafter the changes take place very rapidly. The velocity increase at a given temperature compared with the velocity of the same stage at 10° C. lower (what is known as the Q_{10} value) approximates to the expectations deducible from van't Hoff's law. That is to say, the mitosis behaves in its velocity increments to temperature-increments like the simpler chemical reactions. But this does not mean that mitosis is "a simple chemical reaction." Far from it; we have to deal with a *répertoire* of activities, a vast complex of physical and chemical activities, in which the many aberrations from the velocity-gradient of a simple chemical process are mutually cancelled. The author's study marks a distinct step of advance in the analysis of mitosis.

THE "tillite" with scratched boulders in the Varanger district of Finmarken is referred by Olaf Holtedahl, of Kristiania (*Amer. Journ. Sci.*, vol. xlvii., p. 85, 1919) to a pre-Caledonian epoch, probably Ordovician. A comparison is made with the coarse conglomerates of Girvan in Ayrshire. The paper reviews the Palæozoic rocks of Finmarken, and assigns an inorganic and concretionary origin to the structures known as stromatolites, including Cryptozoön and Gymnosolen. The author cannot agree with Walcott that the limestones containing these objects were accumulated in fresh water, but he thinks that algal activities may have aided in the deposition of the calcium carbonate.

THE zoning of the "Karroo System" of South Africa, which is in reality the representative of more than one system, receives a new investigation from Mr. A. L. du Toit in the Proceedings of the Geological Society of South Africa for 1918 (p. xvii). The author carries the glacial Dwyka series down into the Upper Carboniferous, and the Ecca beds thus become Lower Permian. The Cave Sandstone at the top of the Karroo formation is regarded as an æolian deposit of probably Rhætic age, comparable with the Pleistocene löss of the northern hemisphere. The former wide extension of the overlying Drakensberg lavas, including the basalts along the Zambesi, is indicated, and these are also brought, so far as present evidence goes, within the Rhætic series.

THE Press of Aragon (Spain) has recently published a description of trials made by a Spanish engineer of straw-compound as a substitute for coal. This fuel is said to have great advantages over coal for locomotives and agricultural tractors, as it develops sufficient heat in thirty minutes to give the necessary head of steam. The U.S. Commerce Report No. 86 (1919), reporting this discovery, states that the ashes left by the fuel in question make an excellent fertiliser. Another Spaniard has patented a process for the use of banana fibre for textiles, yarns, cords, and alpargata soles as a substitute for hemp and jute. Trials have proved satisfactory, and plant is to be laid down to work the process.

THE recently issued annual report of the Decimal Association shows that the efforts of the association in favour of the compulsory introduction of decimal coinage and the metric system of weights and measures continue to make satisfactory progress. The Bill brought forward by Lord Southwark last year has aroused the interest of many public bodies, and numerous resolutions have been passed in favour of decimal coinage. The measure will remain in abeyance until the Royal Commission appointed to deal with the subject issues its report, which is expected in the early autumn. A number of local educational bodies have signified their approval of the proposal to introduce the metric system of weights and measures. British Chambers of Commerce abroad are actively supporting the proposed reform, as they regard the adoption of the metric system by this country as an essential preliminary to success in supplanting German ascendency in foreign markets. Although the use of the system has been for many years permissive in the United Kingdom, business firms adopting it suffer much inconvenience owing to the railway companies refusing to accept consignment notes made out in terms of metric weights; this difficulty will continue to hamper progress until the system is made obligatory. The *Decimal Educator*, a quarterly journal started by the association during the year, has met with a marked measure of success.

WITH reference to Irish reconstruction problems, the question of producing industrial alcohol was discussed by Dr. J. Reilly, of the Royal Naval Cordite Factory, in a lecture delivered before the Royal Dublin Society a short time ago. One of the chief points suggested for consideration was whether, by the use of alcohol as a motor-fuel, the dependence of this country upon foreign supplies of petrol could not be obviated or lessened. We import about 150,000,000 gallons of petrol yearly. To replace this by alcohol obtained from potatoes about 7,000,000 tons of the latter would be required. Allowing for rotation crops, this quantity of potatoes would require some 6,000,000 acres of land for its production. At present Ireland grows about 4,000,000 tons of potatoes per annum. She could grow more, no doubt, though how much more is not at present very clear. Assuming that the requisite amount of land could be spared after food needs were supplied, the practical test of the matter would be the price of the alcohol produced in relation to that of petrol. As to this the lecturer gives no dogmatic pronouncement; he only suggests that there is a case for consideration. In a country such as Ireland, with a large agricultural population, it is essential for prosperity that the land should be made to provide more wealth,

both in the shape of food and in that of raw material for industry. It has been argued that crops with a higher starch-content can be grown more cheaply in tropical countries, and the resulting alcohol could, and would, be imported here. Against this Dr. Reilly remarks truly that it is unwise for a country to rely solely on foreign supplies.

AMONG forthcoming books of science we notice the following:—Vol. iii. of the English translation, by H. Spencer-Browne, of Doyen's "Surgical Therapeutics and Operative Technique" (*Baillière, Tindall, and Cox*); "The Story of the English Public Health," Sir Malcolm Morris, and "Infant and Young Child Welfare," Dr. H. Scurfield (each in the new series of English Public Health) (*Cassell and Co., Ltd.*); "The Natural History of the Child," Dr. C. Dunn (*Sampson Low and Co., Ltd.*); and a new and revised edition of "Mental Diseases," Dr. H. R. Cole (*University of London Press, Ltd.*). "The Chemical Trade Year-Book" is in preparation by *Messrs. Bandon and Morris*, of Red Lion Passage, W.C.1.

MR. F. EDWARDS, 83 High Street, Marylebone, has just issued a catalogue (No. 391) of nearly 1000 items relating to the Dominions, Colonies, and Dependencies of the British Empire. It contains many scarce works, is carefully classified, and will doubtless interest many readers of NATURE. Mr. Edwards has also circulated a short list (No. 390) of new books at remainder prices. Many of the volumes deal with scientific subjects. The catalogues will be sent free upon application.

THE Scientific Attaché to the American Embassy informs us that the position of the solar prominence referred to in the cablegram from Dr. L. A. Bauer published last week (p. 311) was wrongly recorded. A further message states that the position should have been given as *south*-south-west instead of *west*-south-west.

OUR ASTRONOMICAL COLUMN.

THE PLANETS.—The three bright planets which have been so conspicuous during the last few months are now leaving the evening sky. Jupiter will be in conjunction with the sun on July 21, Saturn on August 25, whilst Venus, which will be at greatest elongation 45° E. on July 5, is approaching greatest brilliancy (August 8), and will be at inferior conjunction on September 13. Mars is coming into view as a morning star rising in the N.E.

On the evening of July 2, at 9h. G.M.T., a very close and interesting approach of Venus and Saturn may be observed in the W.N.W. sky. The two objects will be separated by an apparent distance of 10′ of arc. Venus will set at about 10.30 G.M.T., and will be a brilliant object, offering a strong contrast to the feeble appearance of Saturn in the strong twilight. It will be interesting to examine the two planets in the same field of view with a good telescope, and to note the great difference in colour and brilliancy to the unaided eye. This conjunction will form one of the most attractive planetary configurations of 1919. It is true that the conjunction of Venus and Saturn is not a rare event, although one of the same character as that to which we are now referring is very seldom observed, since it will take place at a very convenient time for observation and the objects will be unusually near each other. On a few evenings preceding and following July 2 the changes in the relative places of Venus and Saturn will be considerable, and it will be entertaining to trace them from night to night.

ADMIRALTY TIDE-TABLES.—A sentence in the Astronomer Royal's report, noticed in last week's NATURE, may have given rise to misconception. The day used in the Admiralty tide-tables for the current year and previously begins at midnight, and is divided into two periods of twelve hours, a.m. and p.m. respectively. The change to be introduced into the issue of the tables for 1920 is that the hours will be numbered from 0 to 23.

THE NATIONAL PHYSICAL LABORATORY.

THE annual visitation and inspection of the National Physical Laboratory by the General Board took place on Tuesday, June 24. The numerous visitors invited by the Board made a tour of the laboratory, and were given an opportunity of seeing in operation various subjects of interest which are at present being investigated at the laboratory.

The engineering department exhibited an apparatus for the determination of the absolute viscosities of liquids at high pressures. The liquid under test is arranged to flow through a capillary under a constant-pressure difference, and its velocity calculated from the indications of the instrument. The Lanchester worm-gear testing machine for obtaining the efficiency of a worm-gear was shown. The machine is so arranged that a pressure corresponding to a transmission through the box of as much as 100 h.p. can be obtained between the gear-teeth, it being necessary to supply from an external source only the losses in the gear and apparatus. In the apparatus used for the measurement of journal friction, a tilt due to a force of about 1/300th of a pound weight acting at the end of a 3-ft. lever could be measured. Variations of the coefficient of friction of the bearings due to different oils could be observed with this apparatus. Other exhibits in this department were the following:—An apparatus for testing the wear of stranded cables, an extensometer for use at high temperatures, a high-velocity impact testing machine, and a wear-testing machine.

The aeronautical department demonstrated how data for solving problems such as the following are obtained in the wind channels:—(1) The mutual interference of air-screw and body, and the flow in the neighbourhood of the air-screw; (2) the spinning of aeroplanes; (3) the balancing of rudders; and (4) the determination of the rotary derivations on SS. Zero airship. Various models of complete machines and a model of a mooring device for rigid airships were exhibited.

Demonstrations were given in the metallurgy department of the rolling of high tensile aluminium alloys. The recuperative gas furnace and the electric "ring" furnace for high-temperature work were seen in operation. A chronograph for the direct plotting of time-temperature observations in the form of "inverse-rate" curves, as required for the heating and cooling curves of metals and alloys, was demonstrated. The curve plotted by the instrument may be regarded as the differential coefficient of the simple time-temperature curve representing the observations.

Tests on seaplane-floats were carried out in the William Froude national tank. Two different types of experiment were conducted: (*a*) on resistance, running angle, and longitudinal stability of a float when planing on the water; and (*b*) on the impact of a seaplane when alighting on water, measurements of the deceleration and the blow received by the float being made.

In the large gauge-room, which was added to the metrology department during the war for the purpose of testing gauges used for munitions, were seen different types of gauges and the methods of testing them. During the busiest period of the war some

10,000 gauges were dealt with in this building alone. A minimeter of special design was shown which enabled rapid and accurate measurements to be made on slip-gauges. The instrument serves to indicate the difference between the gauges under test and the corresponding standard gauges kept at the laboratory. A difference as small as one millionth of an inch is readily shown on the scale of the instrument. The following instruments for measuring and inspecting screw-gauges were exhibited:—(1) Screw diameter-measuring machines of the "floating micrometer type," (2) screw-pitch measuring machines for checking accuracy of pitch of screw-gauges, and (3) vertical projection apparatus giving a magnification of 50. Errors of 0·0001″ in the thread form can be detected with this instrument.

The exhibits of the optics division included the following:—A large Michelson interferometer, as modified by Twyman, for testing prisms and lenses; another interferometer used for determining the planeness of flat surfaces and the parallelism of glass plates, on which measurements could be made to within a tenth of an interference fringe; the following methods for the accurate determination of the curvatures of lens surfaces—(*a*) a magnification method for very steep curves such as are encountered in microscope objectives, (*b*) the Guild precision spherometer for medium curves, and (*c*) an arrangement of Newton rings for shallow curves, either convex or concave; a simple projection apparatus for testing mirrors for defects in polishing, silvering, or in quality of the glass; and apparatus for testing blocks of prisms for strain.

The heat division showed an apparatus for testing the heat-insulating properties of materials employed in the construction of cold stores, an apparatus for detecting contaminated regions in thermo-elements, and an instrument (designed by Mr. E. A. Griffiths) for indicating the contents of the petrol tank of aircraft or automobiles. The latter works on the principle that the heat loss from a wire is greater when the wire is immersed in a liquid than when exposed to air or vapour. The instrument is compensated for the effect of varying atmospheric temperatures.

The exhibits of the electricity department included apparatus for the accurate measurement of capacity at low frequencies; an electrical method of measuring frequency; apparatus for measuring the amplifying power of valves at audible frequency; the reception of continuous waves by the heterodyne method; and a three-electrode valve set for producing oscillations of telephonic frequency.

The working of the Paterson-Walsh electrical height indicator was demonstrated. This instrument consists of two observation tubes capable of rotation about parallel axes placed at a known distance apart. The two parts are electrically connected, and the connections are so arranged that the height of the object is given directly on a dial attached to the apparatus. Other items of interest shown were the methods of testing radium dials, the testing of insulators for high-voltage transmission under artificial rain, arc lamps for searchlights, and the heating of buried cables.

PHYSIOLOGY OF SEX AND REPRODUCTION IN POULTRY.

IN numerous animals it seems that the determination of sex depends upon the chromosome content of the egg-cell and sperm-cell. But there is considerable evidence that in some cases the normal sex-ratio may be experimentally modified and in some degree controlled. This led Prof. Raymond Pearl (Proc. Amer. Phil. Soc., vol. lvi., 1917, pp. 416–36) to make a statistical investigation of the sex-ratio in the domestic fowl, and he considers data representing 22,000 chicks. In families of ten and more Prof. Pearl found the ratio of males per 1000 females to be 944, or 48·57 per cent.; and it is very interesting to notice the nearly perfect agreement of this result with Darwin's, which was 48·64 per cent. There is normal variability from stock to stock and from year to year, and aberrant sex-ratios occur. But before these aberrant sex-ratios can be regarded as indicative of either environmental or hereditary effects, it is necessary to show that they occur with such frequency as to exceed considerably the frequency expected on the basis of chance alone. This has not been done. In regard to the flocks Prof. Pearl dealt with, there was evidence that the pre-natal mortality is not differential in respect to sex. It follows that the sex-ratio observed at birth is substantially the same as the initial zygotic sex-ratio—that is to say, the ratio determined by the constitution of the fertilised ovum. In another paper (*Science*, vol. xlvi., 1917, p. 220) Prof. Pearl states that hens with high fecundity as a fixed characteristic tend to produce a larger proportion of female offspring—a very important conclusion.

For measuring the net reproductive ability of mated pairs of the domestic fowl (Barred Plymouth Rocks) Prof. Pearl proposes (*Genetics*, 1917, pp. 417–32) a reproductive or fertility index. This index expresses the actual number of chicks produced by the mating and capable of living three weeks after hatching as a percentage of the maximum total number of chicks which it would be physiologically possible for the mating to produce. It has a mean value of about 12 per cent. Net fertility, as measured by the reproductive index, is a rather highly variable character, agreeing in this respect with other purely physiological characters. As to the influence of age, it is shown that reproductive ability, as measured by the index, diminishes with advancing age of the birds mated, having its maximum when each of the birds mated is from ten to fourteen months old. The rate of decline with advancing age is more rapid in the males than in the females.

In mammals there is a steady increase in the rate of fertility to a maximum, after which, with a further increase in age, there is a decline to total sterility. But in the fowls Prof. Pearl experimented with there is a steady and progressive decline in fertility after the first breeding season (Proc. Nat. Acad. Sci., vol. iii., 1917, pp. 354–56). There is a significant drop in reproductive ability as we pass from a combined age of two years for the mated birds to three years. In passing from three years to four there is no significant change. In passing from a combined age of four years to five there is a large drop in the net reproductive ability of the mating.

Miss Alice M. Boring and Prof. Pearl discuss (*Anat. Record*, vol. xiii., 1917, pp. 253–68, 6 figures) the extraordinarily discrepant statements that are made in regard to the presence or absence of interstitial cells in the testes of male birds. They find these elements in the testes of just hatched chicks. But they may be, and usually are, quite absent from the testes of birds more than six months old and of full sexual maturity as regards both primary and secondary characters. This makes it difficult to believe that the interstitial cells of the testes have (in the case of the fowl) any causal influence upon the secondary sex-characters. The observers found true interstitial cells invariably present in the ovary, and they notice that these elements are structurally identical in the two sexes.

In a joint paper (*Amer. Journn. Anat.*, vol. xxiii., 1918, pp. 1–35, 9 plates, 6 figures) Prof. Pearl and

Miss Boring report the results of their study of the corpus luteum in the hen. Its origin is from the theca interna of the ovary, and it is clearly homologous with the corpus luteum of the cow. The course of its development is an abbreviation or fore-shortening of that in the cow, corresponding, indeed, with the late involution stages. Its resemblance to the corpus luteum of the oviparous duckmole is striking. The corpora lutea in hen and cow contain a similar yellow fatty substance. In both there is a yellow amorphous pigment in the cells containing the fatty substance. In the hen a mass forms in an atretic or undischarged follicle, which is practically identical with the corpus luteum that forms in a discharged follicle.

The same investigators have made a study of eight cases of hermaphroditism in poultry (*Journ. Exper. Zool.*, vol. xxv., 1918, pp. 1–30, 9 plates, 9 figures). The birds in question were females with embryonic or degenerating ovaries. Three were changing to a male condition in respect to reproductive organs, external characters, and even sex behaviour. But no structural counterpart was found for the abnormal behaviour of one hen treading another hen. Development of comb, spur, and wattles does not stand in any direct quantitative relation to the sex-condition of the gonad, but the shape and carriage of the body have a general relation thereto. The amount of lutear cells or pigment is in precise correlation with the degree of external somatic femaleness exhibited by the individual, but it does not appear that the interstitial cells of the gonads have any causal relation to the secondary sex-characters in the abnormal birds here dealt with.

We have not come to an end of the interesting budget of papers from Maine. Thus there is an investigation by Prof. Pearl (*Amer. Naturalist*, vol. li., 1917, pp. 545–99 and pp. 636–39) redefining the concept of inbreeding, and showing how the degree of kinship between any two individuals may be most precisely expressed. There is another by Prof. Pearl and Mr. S. W. Patterson showing that milk production changes with age in a definite manner (following a logarithmic curve), and in Jersey cows reaches its maximum at approximately the age of eight years and seven months.

J. A. T.

SCIENCE AND INDUSTRIAL DEVELOPMENT.

THE British Scientific Products Exhibition, which has been organised by the British Science Guild, and will be opened by the Marquess of Crewe at the Central Hall, Westminster, on Thursday, July 3, will afford an opportunity for vindicating the supremacy of Great Britain in the field of discovery and invention. It will show the strength and variety of home manufactures and indicate the indispensability of science in industry, in peace as in war.

One of the practical results of the exhibition should be to create new markets for new products and establish new industries for dealing with raw materials. The extent to which Germany had derived benefit from the exploitation of these resources and insidiously used her control to our disadvantage was not realised until after the outbreak of war. With this knowledge before us, and the conviction that most strenuous efforts will be made by Germany to appropriate trade and commerce which in Imperial interests we should secure for ourselves, it is of the utmost importance to accentuate the lesson which events have taught us. The exhibition will provide this means of enlightenment and its influence at the present epoch cannot be over-estimated.

We must leave for a later occasion the account of the main features of the exhibition, and direct attention here to the one aspect which deserves special emphasis. Modern industry requires the use of a greater number of skilled research workers and of men with technical knowledge for responsible positions. The census of production (1907) showed that the net annual output per head is generally greatest in those industries which employ the highest proportion of persons receiving salaries as distinct from wages, and it diminishes as one passes to industries where the percentage of wage-earning employees increases. Thus, taking the nine leading industries, but not including coal-mining, the highest annual output per head is 185*l.* in the chemical industries, where 12 per cent. of the persons employed receive salaries and 88 per cent. wages; next in order of annual output per head and proportion of salaried employees come iron and steel factories (118*l.*) and engineering factories, including electrical engineering (108*l.*); and at the bottom of the list are the jute, linen, and hemp factories with a net output of 61*l.* only, the percentage of wage-earners being 98, of salaried persons 2. These figures indicate that the employment of skilled technologists means increased productivity, and they point to the importance of improved training of artisans in technical schools. If research methods are to be more generally applied to industries greater skill and accuracy will be required from the general body of workers, so that it is not merely the duty of the universities and colleges to supply highly trained research workers, but the technical schools have also the important duty of educating the artisan for the new type of work required under the new conditions.

The way to increase the number of highly skilled technologists is to make their position and prospects better than they have been. Many employers still express their preference for the so-called practically trained man over the man with scientific training, whereas in other countries the college-trained technologist finds ready acceptance in all branches of industry. Whether it is accepted or not, the fact remains that much of the commerce and manufacture of the modern world demands the leadership of highly trained, widely informed men, and that these men must be forthcoming if we are to be able to take a leading place among the nations of the world. It should be the purpose of an efficient educational system to provide adequate opportunities for the training of men of this type from whatever station of life they may be selected. Of all methods of reconstruction none is more likely to add to national wealth and strength than the application of science to industry; and the more men there are capable of being entrusted with it, the greater will be the progress.

THE HISTORY OF THE LONDON PLANE.

IN an article on "The Artificial Production of Vigorous Trees," an abstract of which was published in NATURE, January 7, 1915, p. 521, Prof. Augustine Henry directed attention to certain well-known trees, like the Lucombe oak, Huntingdon elm, cricket-bat willow, and black Italian poplar, which owe their vigour and botanical characters to the fact that they are of hybrid origin. Such hybrids arose as chance seedlings due to cross-pollination of two trees of different species growing together. The introduction into Europe during the seventeenth century of North American trees which grew alongside similar, but distinct, European species in parks and gardens was the occasion of considerable hybridisation. Trees like the black Italian poplar and the London plane, which have never been seen anywhere in the wild

state, are intermediate in botanical characters between an American and a European species in each case, and are undoubtedly first-crosses.

The origin and history of the London plane, *Platanus acerifolia,* form the subject of a paper by Prof. Henry which appeared in the Proceedings of the Royal Irish Academy for April last. This tree has all the peculiarities which are met with in a first cross. It is intermediate in fruit and in leaves between the supposed parents, the Oriental plane, which is indigenous in Greece and Asia Minor, and the Occidental plane, which grows in a wild state in the forests of the eastern half of the United States. Its vigour is exceptionally great, as is usual in hybrids of the first generation; and its seeds when sown produce a mixed and varied crop of seedlings, in which are variously combined the characters of the two parents. Several supposed forms of the London plane, which are not uncommonly cultivated, appear to be chance seedlings of this tree, being hybrids of the second generation.

FIG. 1.—*Platanus orientalis.* From Thermopylæ seed.

The London plane is extensively used for planting in the streets of towns of Europe and North America, as it has been found to surpass all other trees in its powers of resistance to drought, smoke, and other unfavourable conditions of soil and atmosphere. In the cities of New England, Ohio, Pennsylvania, etc., the London plane is much more successful as a street tree than the Western plane, notwithstanding the fact that the latter is the finest and largest native broad-leaved tree in the forests of these States. The selection as a street tree of the London plane in preference to the native species in the regions where the latter flourishes depends on the vigour inherent in the former tree on account of its hybrid origin.

The London plane, being undoubtedly a hybrid, must have originated as a chance seedling in some botanic garden where an Occidental plane and an Oriental plane happened to be growing close together. Such a seedling, by the vigour of its growth and the novelty of its foliage, would attract attention and be propagated by an observant gardener. The ease with which the London plane can be raised from cuttings would much facilitate its propagation. Prof. Henry shows that it possibly originated in the Oxford Botanic Garden about 1670, though this surmise cannot be definitely proved.

The Occidental plane was introduced from America into England by Tradescant in 1636, about a century later than the earliest record of the Oriental plane in this country. By 1670 there would have been trees of the American species old enough to bear pollen. The connection with Oxford is as follows:—Jacob Bobart, jun., who succeeded his father as curator of the botanic garden at Oxford in 1680, left in MS. "An Enumeration of Trees and Shrubs," in which for the first time there is mention in any record of the London plane. This MS. is, unfortunately, without date, but a similar MS. has 1666 on the fly-leaf. In the "Enumeration" the planes in cultivation are distinguished as follows:—

FIG. 2.—*Platanus occidentalis.*

No. 475. *Platanus orientalis, pilulis amplioribus.*
No. 476. *P. inter orientalem et occidentalem media.*
No. 477. *P. occidentalis aut virginiensis.*

Corresponding with the diagnosis, No. 476, of the London plane, as intermediate between the Oriental and the Occidental species, there is a dried specimen, undoubtedly *P. acerifolia,* in the Sherard Herbarium at Oxford labelled *"Platanus media."*

The first published description of the London plane was by Plukenet in 1700 in his "Mantissa" (p. 153), which reads as follows:—"Platanus orientalis et occidentalis mediam faciem obtinens, Americanus, globulis grandioribus, foliis splendentibus atris." The type-specimen of this description is in the British Museum, Herb. Sloane, No. 101, folio 112. In addi-

tion, there are two sheets of specimens, collected by Petiver about the same period, one of which, Herb. Sloane, No. 149, folio 237—two fine leaves of *P. acerifolia*—is labelled "*Platanus media*, n.d., Bobart, Ox." It is possible that the original tree from which this specimen was taken by Bobart was then living in the Oxford Botanic Garden. As Plukenet describes this plane as bearing large fruit-balls in 1700, it may have been then thirty years old, which would give the date of origin of *P. acerifolia* as 1670.

This history synchronises well with the date of the magnificent London plane, probably the oldest in Europe, which is living in the Palace Garden at Ely, and now measures 110 ft. high, the trunk being 23 ft. in girth at 5 ft. above the ground. It was planted by Gunning when he was bishop there between 1674 and 1684. Bishop Gunning spent some time at Oxford before his appointment to the Ely diocese.

The splendid London plane at the Ranelagh Club, Barnes, is precisely of the same size as the Ely tree, and is probably of the same age, both these trees

FIG. 3.—*Platanus acerifolia.* Kew.

being apparently cuttings of the original tree, which is postulated in this account to have been in the Oxford Botanic Garden. There is no record of the age of the Ranelagh Club tree. There are two other immense London planes, probably coeval with the Ely tree, namely, one at Peamore, near Exeter, and the other at Woolbeding, Sussex; but no particulars of their history can be obtained.

On the Continent there are no examples of the London plane approaching in size or age the fine trees at Ely and Barnes; and no mention is made of it by any Continental writer before 1703, when it was briefly described by Tournefort. Since the latter date the cultivation of the London plane has spread over the Continent, and it is now common in towns in France and Germany. In the United States, as stated above, it is widely cultivated as a street tree, but almost invariably under the erroneous name of *P. orientalis*. The true *P. orientalis* is very rare in America, and is never used for planting in streets.

Various seedlings of the London plane have been selected from time to time, and one of them, *P. pyramidalis*, which originated on the Continent about 1850, is now as commonly planted in the streets of our towns as the true London plane. Another seedling, *P. hispanica*, a beautiful tree resembling the Occidental plane in foliage, was known in England before 1731, and must have come from seed of one of the earliest London planes. The history of *P. hispanica* is as follows:—Miller, in his "Dictionary" (seventh edition published in 1759), mentions in all four planes. The Occidental and Oriental planes, he says, "are undoubtedly distinct species, but there are two others in English gardens, which I suppose to be varieties that have accidentally risen from seed; one is titled the maple-leaved plane (*P. acerifolia*), and the other is called the Spanish plane-tree." He considered *P. acerifolia* to be a seminal variety of *P. orientalis*, as seeds of a large Oriental

FIG. 4.—London plane at Ely.

plane in Chelsea Garden produced plants of this sort several times. His description of the Spanish plane is unmistakable: "It has larger leaves than the other sorts, more divided than those of the Occidental plane, sharply indented in the edges, light green, foot-stalks short and covered with a light down. It grows faster than the other sorts, but I have not seen any very large tree of this kind." He further states that he planted four planes, one of each sort, in 1731.

It would appear from this evidence that *P. hispanica* originated some time before 1731, and was probably a seedling of one of the early London planes, which by this time had been bearing seed for many years. This beautiful tree has always been rare in cultivation. There are, however, two fine trees at Kew, which have tall, straight stems, with ascending branches above and pendulous branches below, bearing magni-

ficent foliage. *P. hispanica* has been considered by many authors to be a variety of *P. occidentalis*, but the achenes clearly show it to be of hybrid origin.

The history of the other peculiar planes, here regarded as hybrid seedlings of the second generation on account of their botanical characters, is obscure. They may ultimately prove to be identical with young seedlings of *P. acerifolia* which are now growing at Kew and Glasnevin, when these in after years acquire adult foliage and bear fruit. This would be a positive proof of their hybrid origin.

The botanical characters of the two parent species, of the London plane, and of the supposed descendants of the latter, six of which are in cultivation, have been carefully investigated by Prof. Henry, assisted by Miss M. G. Flood. The numerous differences observable in the achenes, fruit-balls, and leaves of these trees prove to be exactly of the same kind and range as occur in hybrids artificially produced, and afford presumptive evidence that from *P. acerifolia*, an accidental cross between two wild species, the other planes, such as *P. pyramidalis*, *P. hispanica*, etc., only known in the cultivated state, are descended.

When the seed of a first-cross is sown the seedlings produced constitute a mixed and varied crop, in which are variously combined the characters of the two parents. The best proof, then, of the hybrid nature of *P. acerifolia* is the fact that it does not come true from seed, which appears to have been known to Lorberg in 1875 and to Gadeceau in 1894. Two sowings made in recent years establish this very clearly. There are now eight seedlings planted in the Queen's Cottage grounds at Kew which were raised from seed of *P. acerifolia* that was sown in April, 1911. These range in height from 4 ft. to 10 ft., and are very diverse in foliage, some closely resembling *P. orientalis*, and others resembling *P. occidentalis*, a few being intermediate. One of them appears to be identical with *P. hispanica*. There are also two seedlings at Glasnevin, which are the only survivors of a set raised at Cambridge in 1910 from seed of a large London plane growing near the main gate at Kew. The rest of the set died from drought, having been transplanted into a field in that dry year. These two seedlings are extremely unlike in foliage; one has leaves indistinctly lobed, resembling those of *P. occidentalis*; the other has deeply lobed leaves, and differs little from *P. orientalis*.

The artificial production of a cross between *P. orientalis* and *P. occidentalis* has not been possible in this country, where there exists no adult living tree of the latter species from which pollen could be obtained. An attempt to reproduce *P. acerifolia* by cross-pollination of the Occidental and Oriental planes might be made in the United States, using the native tree as the female parent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. H. Rastall, of Christ's College, has been appointed University lecturer in economic geology, Mr. Herbert Stone University lecturer in forestry, and Mr. F. Debenham, of Gonville and Caius College, University lecturer in surveying and cartography.

Mr. T. C. Nicholas, of Trinity College, has been appointed assistant to the Woodwardian professor of geology, and Mr. J. M. Wordie, of St. John's College, demonstrator of petrology.

Mr. A. W. Hill, of King's College, and Mr. E. H. Rayner, of Trinity College, have been approved for the degree of Sc.D.

EDINBURGH.—The University Court, on the recommendation of the Senatus, has resolved to re-establish the lectureship in military history and strategy. It has also been resolved to institute a diploma in public health.

Dr. H. S. Allen, reader in physics, King's College, London, and secretary of the Physical Society of London, has been appointed lecturer in natural philosophy.

MR. S. C. MONK has been appointed lecturer in electrical engineering at the Devonport Technical School.

THE resignation of Dr. R. L. Weighton of the chair of engineering at Armstrong College, Newcastle-upon-Tyne, is announced.

THE first award of the William Gibson research scholarship for medical women (minimum 250*l.* per annum) has been made to Miss M. Esther Harding. The scholarship is held for two years.

IT is announced in the *Times* that Capt. S. E. Whitnall, University demonstrator of human anatomy, Oxford, has been appointed professor of anatomy at McGill University, Montreal, Canada; and that the same University has appointed Capt. John Tait, lecturer in experimental physiology in the University of Edinburgh, to the Drake professorship of physiology.

AMERICAN university women have founded a fellowship as a memorial to Miss Sidgwick, one of the two women members of the British Educational Mission which paid a visit last year to the United States, where the death of Miss Sidgwick occurred. The fellowship is to be awarded annually to a British woman for a year's graduate research work at an American college or university. For 1919–20 it will be tenable at Columbia University, New York. Particulars may be obtained from, and applications made to, Miss L. C. Kempson, Bedford College for Women, Regent's Park, N.W., before July 1.

THE council of the University College of South Wales and Monmouthshire has appointed Dr. A. H. Trow to the office of principal of the college. Principal Trow became head of the department of botany at the College of South Wales and Monmouthshire in 1893, and obtained the degree of D.Sc. of the University of London in 1899. He has been Acting-Principal of the college since the retirement of Dr. E. H. Griffiths in September, 1918. His chief publications are on the biology and cytology of aquatic fungi and on genetics. His studies of the common groundsel constitute a valuable addition to our knowledge of the inheritance of quantitatively variable characters. The work that will devolve upon Principal Trow for the next few years under the scheme of reconstruction to be effected as the result of the Report of the Royal Commission on University Education in Wales will be of a critical character, and of vital importance for the growth and evolution of the institution.

School Science Review, the new publication promoted by the Association of Science Masters (formerly the Association of Public School Science Masters), will be greatly appreciated by all interested in the progress of science. To teachers themselves it will supply that long-felt want: a medium for the regular interchange of opinions from the schools point of view, and for the record of new ideas in courses and experimental work; to wider educational circles it will show clearly what is being done in the leading schools for the advancement of science. The first number runs to thirty-two pages of most readable material. Mr. C. L. Bryant, of Harrow, writes a valuable account of the

work and influence of the association since its inception in 1900. Mr. Durrant, of Marlborough supplies a contribution dealing with ions in solution, and gives many valuable suggestions for the treatment of the subject in schools. Sir William Tilden deals with the aims, objects, and methods of science teaching, and lays stress upon the value of research work in science classes. Mr. Hough (Oundle), in an illuminating article on research, appeals for an extension of such work among school pupils, and gives definite examples of how school researches have helped to solve industrial problems. Mr. Hart-Smith (Battersea) contributes an account of recent advances in chemistry, and space is found for notes on apparatus and experiments, reviews, and current topics. The Review, which is to be published four times a year, is replete with interesting matter, and the editor (Mr. Adlam, City of London School) may be warmly congratulated on the excellence of the publication.

THE Lords Commissioners of his Majesty's Treasury, in consultation with the President of the Board of Education, the Secretary for Scotland, and the Chief Secretary for Ireland, have appointed a Standing Committee "to inquire into the financial needs of university education in the United Kingdom and to advise the Government as to the application of any grants that may be made by Parliament towards meeting them." The first members of the Committee, which will be known as the "University Grants Committee," are as follows:—Sir William M'Cormick (chairman), Prof. W. Bateson, F.R.S., Sir Dugald Clerk, K.B.E., F.R.S., Sir J. J. Dobbie, F.R.S., Miss S. M. Fry, Sir F. G. Kenyon, K.C.B., Sir Stanley Leathes, K.C.B., Sir William Osler; Bart., F.R.S., and Sir J. J. Thomson, O.M., F.R.S. It may be recalled that in NATURE for August 15 last an article was published in which particulars were given of the position of university and higher technical education in the United Kingdom in 1913–14 in comparison with the United States and Germany. The article was afterwards made the basis of a report issued by the British Science Guild upon "Industrial Research and the Supply of Trained Scientific Workers." Since then the Civil Service Estimates for 1919–20 have been issued (see NATURE, April 10), and they show that the total amount of the grants to be paid out of the Exchequer for the maintenance of university institutions is 1,000,000*l*. instead of about 500,000*l*. There is also a supplementary non-recurrent grant of 531,000*l*. in aid of maintenance of universities and colleges. The Committee just appointed is apparently to inquire into financial needs only. What is wanted is a Commission to make a broad survey of the whole subject of university and higher technical education from the point of view of national needs and how far the existing provision satisfies them.

IN the form of a thirty-two-page pamphlet, Mr. Frank Stevens, the resident curator, has sent us "Some Account of the Educational Work at the Salisbury Museum, 1916–19." This work consists essentially of classes for school children, beginning with the elementary schools of the city, extending to those of the adjacent villages and to some of the secondary schools, and, finally, to some bodies of adult students. The school classes, begun in 1913 as private and informal talks by Mr. Stevens, developed by 1916 into an historical course sanctioned by the educational authorities as part of the school lessons. The first course dealt with prehistoric and early historic times, in relics of which the neighbourhood and the museum of Salisbury are so rich. The pamphlet gives synopses of this and later courses, and indicates the objects used in illustration of each lecture. "The museum specimens," as Mr. Stevens happily puts it, "took the place of the experiments at a chemical lecture in impressing the facts of the lecture." But they did more than that; they emphasised the relation of the home locality to national life, and showed how the general course of history was reflected in Salisbury. Thus a living interest was given to a lesson that is too often a dry memorising of names and dates, intelligence was trained, and citizenship cultivated. The value to the children is obvious. But the museum has also been a gainer. The number of adult visitors has increased every year, and this growth of the public interest in the collections has led to an increase in donations and subscriptions. Further, under the terms of the Wilkes bequest, a sum of 300*l*. per annum has been allotted for the continuance of the school classes. Mr. Stevens has laboured, and now writes, with a justifiable enthusiasm. His example is most worthy to be followed, and those who would follow it should beg a copy of his pamphlet.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 5.—Sir J. J. Thomson, president, in the chair.—Dr. P. **Phillips**: The relation between the refractivity and density of carbon dioxide.—P. N. **Ghosh**: The colours of the striæ in mica, and the radiation from laminar diffracting boundaries. (*a*) The striæ are shown by an examination of the Haidinger's rings in mica (and otherwise) to be the boundaries between parts having slightly different thicknesses. (*b*) The colour of any stria as seen in the Foucault test is complementary to the colour of the central fringe in the laminary diffraction-pattern produced by it. (*c*) The colours are altered by holding the mica obliquely, or by immersing it in a cell containing liquid. (*d*) The luminosity of a stria in the Foucault test is approximately a maximum when the phases of the wave-front, after passing through the plate on the two sides of the stria, are opposite, and practically zero when the phases are identical. (*e*) Attempts to reproduce the phenomenon by etching glass plates with dilute hydrofluoric acid were not very successful, owing, apparently, to a want of sufficient sharpness in the boundary thus produced. This is indicated by the fact that such a plate shows distinct *asymmetry* with reference to the direction of the incident light, both in the Foucault test and in laminar diffraction. (*f*) The striæ in mica appear doubled (with a black line in the centre) when the light coming to a focus is screened in a symmetrical manner, instead of by a knife-edge, as in the Foucault test.—Dr. E. F. **Armstrong** and Dr. T. P. **Hilditch**: A study of the catalytic actions at solid surfaces. The rate of hydrogenation of a number of unsaturated fatty oils in presence of finely disseminated nickel has been studied and the results expressed in the form of curves. These are characterised by an initial linear segment followed by an abrupt change of direction to a segment of gentler slope, which is also linear at first, but subsequently may exhibit considerable curvature. The point of inflexion is at a corresponding part of each curve. The two well-defined linear components of the curves correspond with the hydrogenation of glycerides more unsaturated than olein and to the hydrogenation of olein. The curves never approach the logarithmic type required for a unimolecular action. The general aspect of the curves obtained for catalytic hydrogenation is markedly similar to those obtained in the case of enzymes, and they undoubtedly represent related phenomena.

Royal Meteorological Society, June 18.—Sir Napier Shaw, president, in the chair.—Sir Charles **Close**: Note on the rainfall at Southampton and London during a period of fifty-seven years (1862–1918). The variations in rainfall in England are so great that any seasonal period can be detected only by the study of many years' statistics. Even when the statistics are available for a long period, the form in which they are usually published does not readily lend itself to a clear appreciation of the existence of a simple seasonal period. Thus the monthly means are usually uncorrected for variation in the lengths of the months, and the custom of treating the months separately produces an effect of discontinuity. If, however, after correcting for monthly inequalities, the *accumulation* of rainfall, reckoning from any fixed date, is tabulated and plotted, the rainfall assumes a more regular aspect. If, further, from these monthly figures of accumulation we deduct the average precipitation, the remaining figures approximate to a simple sine-curve with an annual period. The irregularities left over occur chiefly in September and October. The fifty-seven years' rainfall at Southampton, from 1862–1918, have been examined in this way, and the London rainfall for the same period. For Southampton, counting from April 1 (but any date will do), the accumulation, in inches at n months, as represented by the expression

$$2{\cdot}63 \times n - 0{\cdot}95 - 1{\cdot}35 \sin(n \times 30^\circ - 45^\circ).$$

For London by the expression

$$2{\cdot}13n - 0{\cdot}7 \sin(n \times 30^\circ).$$

The maximum irregularities left over amount to 0·30 in. and 0·20 in. respectively on October 1. It would appear, then, that at the places in question the rainfall can be considered to result from uniform precipitation throughout the year, modified by a simple annual harmonic term, further modified by small irregularities in September and October.—Lieut. J. **Logie**: Note on tornadoes. The paper aimed at showing that no convection currents are capable of producing tornadoes of the intensity claimed for some of these storms. Working from the equation $dp/dh = -gD$ (which is shown to be sufficiently accurate for the purpose in hand, even in a tornado-centre), and assuming that at some height the pressure above the tornado is equal to that at the same level outside, the author computes the difference of temperature between the air in the centre of the tornado and that outside. For a tornado having a pressure reduction of 50 millibars at the surface the mean temperature difference is found to be 23° Å. if the tornado extends only to 5 km. (16,000 ft.), 10° Å. if it extends to 10 km., and 5° Å. if it extends to 15 km. From the known values of the lapse-rate of saturated air, it follows that under conditions of maximum instability a saturated ascending current not less than 8 km. high might produce a tornado of this intensity. Since such instability rarely occurs, and, in addition, ascending currents of saturated air are usually everywhere penetrated by descending masses of cooler air, even a tornado of this intensity is unlikely to be so produced in natural conditions. The case of a 250-millibar reduction is also considered as being at times actually achieved. In this case the temperature difference, even if the tornado reaches 15 km., is shown to exceed 35° Å., a difference not capable of being produced by the release of latent heat due to condensation of cloud, and still less likely to be caused by simple heating of the ground surface. It is suggested that the required rise of temperature may be due to the lightning which is usually described as a characteristic of the funnel-cloud.—Capt. D. **Brunt**: A periodogram analysis of the Greenwich temperature records. The monthly mean temperatures at Greenwich for the years 1841–90 were taken and represented by a Fourier series up to 100 terms, so as to permit of the detection of any periods of length greater than one year. Periods of 9·5 years, 5 years, 4 years, 23 months, and 20 months were shown to exist, all having amplitudes of the order of 0·5° F. Some of these correspond with periods found in other meteorological records, *e.g.* the 20-month period has been found by Prof. Turner in the rainfall records of Greenwich and Padua. The interval covered by the observations was insufficient to permit a detailed discussion of periods of length greater than about ten years. Many of the periods found were not continuous during the whole interval covered by the observations, *e.g.* the 20-month period died away about 1894, being replaced by a period of about 23 months. The general result of the investigation was to show that periods in astronomical sense do not exist in these temperature records. It was shown that the effect of correcting the observations for the effect of the periods found was to produce an almost inappreciable diminution of the standard deviation of the observations, tending to show that the variations of the monthly mean temperatures from year to year are to be regarded either as purely chance variations or as due to periods of length less than a year.—Lieut. G. **Green**: The propagation of sound in the atmosphere. Sound-waves emitted by a source situated on the earth's surface generally undergo refraction as they advance owing to the changing conditions of wind velocity and of temperature as the waves pass from layer to layer of the atmosphere. In the paper a mathematical discussion is given of the paths of sound-rays issuing in all directions from a source, under certain conditions of wind velocity and temperature closely resembling the conditions generally to be observed in the atmosphere. The mathematical results obtained would make it possible to calculate the mean speed of sound in any chosen direction from a source to a recording instrument at a given distance from it, provided observations of the horizontal velocity of the wind and of the mean temperature of the air have been taken at the earth's surface and at various heights above the surface. The mean horizontal velocity of a sound element in tracing out a ray is equal to the sum of the velocity of sound and the horizontal component of wind velocity in the plane of the ray, taken at a height above the earth's surface equal to one-third the total height reached by the ray. Numerical results are given for special cases to illustrate the effect of a given wind gradient on the propagation of sound in all directions from a source; and the effect of the same wind gradient combined with a favourable, and also an unfavourable, temperature gradient. The case of a wind increasing in velocity and veering as we ascend from the earth's surface is illustrated in the closing section of the paper.

Institution of Mining and Metallurgy, June 19.—Mr. H. K. Picard, president, in the chair.—W. H. **Goodchild**: The genesis of igneous-ore deposits. The primary object of this paper is to provoke discussion. Its scope is limited to the synoptic presentation of a few of the more important principles and processes concerned in the formation of ore deposits from rock magmas, together with an outline of sundry more or less novel methods for elucidating the nature of those processes. Starting out with the fundamental principle that "the meaning of a vast number of the structures with which the geologist is confronted—either in the field on the grand scale, or in the laboratory with his small specimens—cannot, as a rule, be correctly

gauged without some considerable knowledge of the various physico-chemical equilibria within the masses at various stages of the general cooling process," the author proceeds to enunciate four leading principles as laid down by Le Chatelier, van't Hoff, Ostwald, and Henry as a basis for calculating the general characters and directions of the chemical changes occurring during the cooling. He then deals with the volume relationships of minerals and the problem of volcanic power, the evolution of igneous rocks by magmatic differentiation, and the formation and behaviour of submagmas, from which he goes on to classify igneous-ore deposits under three types, namely, those due to precipitation concentration, solution concentration, and a third group which appears to arise from the degasification of enriched subsidiary magmatic differentiates, this latter class not improbably including the metallic copper of the Lake Superior region and the gold deposits of the Rand. The author's endeavour is, however, rather to illustrate a method of attack on some of the problems than to discuss in detail any particular deposits, and he urges a more extended practice of what he terms magmatic geology as a means to that end.

EDINBURGH.

Royal Society, June 2.—Dr. John Horne, president, in the chair.—Dr. L. **Dobbin**: The presence of formic acid in the stinging hairs of the nettle. The generally accepted view that formic acid is present in the stinging hairs of nettles is not convincingly established by previous investigations in which nettles, as a whole, and not exclusively the cell-contents of the stinging hairs, were submitted to examination. The author has secured the collection of these cell-contents alone, and the conversion of the free acid or acids which they contain into corresponding salts, by pressing the leaves of growing nettles between strips of the purest filter-paper previously impregnated with barium hydroxide or sodium carbonate and dried in air. The optical characters of the lead and barium salts prepared from the material so collected were examined by aid of the polarising microscope, and the various preparations were found to include crystals possessing the same characters as known specimens of lead formate and barium formate.—Dr. R. A. **Houstoun**: X-ray optics. Part i. A method that the author developed ten years ago for calculating the number of electrons per molecule concerned in the production of an absorption band is applied to absorption bands in the X-ray region. The mean result for five "K" bands comes out 1·002. This is at once a verification by a new method of the wave-lengths in the X-ray region, and a guarantee that the theory of dispersion holds in this region. Other X-ray problems are then treated.—Dr. A. C. **Mitchell**: Pulsations of the vertical component of terrestrial magnetic force. An account was given of observations recently made at Eskdalemuir Observatory of pulsations in the vertical component of the earth's magnetic force. Although the ordinary recording magnetograph may apparently register an undisturbed state of the earth's magnetism, minute investigation by means of large loops of cable laid over the ground shows that there is continual agitation going on. This state of disturbance is less noticeable during the night than during the day; it takes peculiarly characteristic forms during displays of the aurora; while the method of observation is sufficiently delicate to observe oscillation periods as low as one-seventh of a second. These very rapid oscillations are, it is believed, identical with the fundamental period of the earth's oscillation as an electrified sphere. Other sudden changes, such as those which frequently usher in a magnetic storm, can also be studied in detail by this method.—Col. R. A. **Marr** (Norfolk, Virginia, U.S.A.): Samples of encysted wood. This wood, obtained from the Balsa tree, is extremely light, its density being about half that of cork. Unfortunately, it rotted easily in its natural state, but by a special process discovered by the author a waterproofing mixture could be carried to the centre of any piece of timber, coating the cells and ducts with an extremely thin permanent film. In this form the wood had been of great service in floating mines during the war.

PARIS.

Academy of Sciences, June 2.—M. Léon Guignard in the chair.—E. **Picard**, B. **Baillaud**, and M. **Ferrié**: A project of the Bureau des Longitudes relating to the determination of a network of longitudes and latitudes all over the world. Three points are suggested: Paris, Shanghai, and near San Francisco. The differences of longitude are to be determined by comparisons between pendulums using wireless signals. The precision attainable should be of the order of 0·01 sec. of time. Greenwich and a point in New Zealand are suggested as additional points on the chain.—H. **Deslandres**: Observations relating to the total eclipse of the sun on May 29, made at the Meudon Observatory. The eclipse was not visible at Meudon, and it did not prove possible to organise an expedition on account of war conditions. Observations of an unusually large prominence were made. Experiments on wireless communication with the Island of Ascension were also made; the signals from this station are not usually perceived during the daytime, but at the moment the umbra and penumbra of the moon produced a weakening of the normal illumination on that portion of the earth between Ascension and France the signals were clearly made out.—G. **Bigourdan**: The unification of astronomical and civil time. It has been agreed between the United States, Great Britain, and France that, commencing January 1, 1925, the astronomical day shall commence, like the civil day, at midnight.—M. **Tilho**: A scientific expedition of the Institute of France in Central Africa. Geographical sketch of the Tibesti, Borkou, and Ennedi.—M. Emile Bourquelot was elected a member of the section of chemistry in succession to the late M. Jungfleisch.—G. **Julia**: Integral functions and growth.—E. **Kogbetliantz**: The summation of divergent series.—J. **Rey**: The flow of petrol vapour.—P. **Fox**: Measurements of stellar parallax at the Dearborn Observatory. Data for thirty-five stars are given, obtained by the photographic method. The accuracy is about 0·01 sec.—E. **Belot**: New data on the primitive solar nucleus, its encounter with the original nebula, and the formation of spiral nebulæ.—M. **Marti**: A method of sounding at sea from a moving vessel, based on the propagation of sound in water. A small charge of explosive is detonated. A microphone receives and records the original sound, and then its echo, reflected off the sea-floor. The accuracy of reading permits of detecting differences in depth to about 1 metre, but the uncertainty of the mean temperature of the water introduces an error of about 0·3 per cent.—L. **Dunoyer**: The error in dead-reckoning involved by incomplete knowledge of the wind velocities.—H. **Abraham** and E. **Bloch**: The measurement in absolute value of the periods of high-frequency oscillations.—M. **Boll**: The evolution of very dilute solutions of tetrachloroplatinic acid in total darkness and at varying temperatures.—G. **Chavanne** and L. J. **Simon**: The critical solution temperatures in aniline of the principal hydrocarbons contained in petrol. Seventeen hydrocarbons were examined, and these were found to fall in three main groups: the aromatic hydrocarbons miscible at the ordinary temperature;

paraffins, ranging from pentane to octane, with a critical solution temperature of about 72° C.; and saturated cyclic hydrocarbons with a critical solution temperature of about 36° C.—M. **de Mallmann**: The system chlorine-hypochlorous acid-sodium hypochlorite.—M. **Dalloni**: The dome of Noisy-les-Bains and the Habra (Algeria).—M. **Mascré**: The *rôle* of the nutritive layer of pollen.—H. **Piéron**: The part played by physiological energy losses in the relation which unites the time of sensorial latency to the intensity of stimulation.—J. E. **Abelous** and J. **Aloy**: The inversion of saccharose by mechanical ionisation of water. A 5 per cent. solution of sugar in water, after five passages through a spray pulveriser, contained the same amount of invert-sugar as a similar solution to which four drops of pure hydrochloric acid has been added and left in repose for the same time (40 minutes).—A. **Vandel**: The determinism of the two modes of reproduction of *Polycelis cornuta*.—MM. **Hartmann** and **Peyron**: Neo-formations of chorio-ectodermic origin in tumours of the testicle.

June 10.—M. Léon Guignard in the chair.—G. **Bigourdan**: Co-ordinates and instruments of the observatory for navigation. Historical account of the position and instruments in the observatory in the Hôtel de Cluny, dating from about 1750–75.—A. **Rateau**: Theory of the flight of aeroplanes at various altitudes.—E. **Borel**: The theory of ensembles and the decimal numbers.—P. **Boutroux**: A mode of definition of a class of multiform functions in the whole of the domain of existence of these functions.—H. **Cramer**: The distribution of the prime numbers.—F. **Michaud**: The vapour-pressure of liquids in thin layers. Starting with data by Devaux on the variation of the surface tension of a thin film of one liquid on another, such as oil on water, it is shown that the vapour-pressure of the oil on the water under these conditions is reduced to about 1/5000th of the normal saturation-pressure. Similar considerations apply to the case of a thin film of a liquid on a solid, such as water on glass.—Ph. **Glangeaud**: The casual or superposition volcanic group of the Mont Doré massifs.—C. E. **Brazier**: The influence of the vertical distribution of temperatures on velocities of the wind measured in the neighbourhood of the soil.—G. **Bertrand**: The preservation of fruit without the addition of sugar, alcohol, or antiseptics, and without sterilisation by heat. Fruit washed in cold water can be kept in a good state of preservation in cold water, provided that the bottles are completely filled and that air is wholly excluded.—R. **Fosse**: The mechanism of the artificial formation of urea by oxidation and the synthesis of natural principles in plants.

BOOKS RECEIVED.

The Analytical Geometry of the Straight Line and the Circle. By J. Milne. Pp. xii+243. (London: G. Bell and Sons, Ltd.) 5*s*.

Projective Vector Algebra: An Algebra of Vectors Independent of the Axioms of Congruence and of Parallels. By Dr. L. Silberstein. Pp. vii+78. (London: G. Bell and Sons, Ltd.) 7*s*. 6*d*. net.

Physical Laboratory Experiments for Engineering Students. By Profs. S. Sheldon and E. Hausmann. Part i.: Mechanics, Sound, Heat, and Light. Pp. v+134. (London: Constable and Co., Ltd.) 6*s*. net.

Photography: Its Principles and Applications. By A. Watkins. Second edition. Pp. xvi+333. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

Farm Concrete. By K. J. T. Ekblaw. Pp. xi+295. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

The Modern Milk Problem in Sanitation, Economics, and Agriculture. By J. S. MacNutt. Pp. xi+258+plates xvi. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

Peach-Growing. By H. P. Gould. Pp. xxi+426+plates xxxii. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

Navigation By Prof. H. Jacoby. Second edition. Pp. xi+350. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 11*s*. 6*d*. net.

The Causes and Course of Organic Evolution. By Prof. J. M. Macfarlane. Pp. ix+875. (New York: The Macmillan Co; London: Macmillan and Co., Ltd.) 17*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 26.

ROYAL SOCIETY, at 4.30.—Dr. A. E. H. Tutton: Monoclinic Double Selenates of the Cobalt Group.—Hertha Ayrton: A New Method of Driving off Poisonous Gases.—Dr. F. W. Aston: Experiments with Perforated Electrodes on the Nature of the Discharge in Gases at Low Pressure.—Mary Seegar and Prof. Karl Pearson: De Saint-Venant Solution for the Flexure of Cantilevers of Cross-section in the Form of Complete and Curtate Circular Sectors; and on the Influence of the Manner of Fixing the Built-in End of the Cantilever on its Deflection.—Dr. H. Jeffreys: The Relation between Wind and the Distribution of Pressure.—Prof. C. H. O'Donoghue: The Blood Vascular System of the Tuatara, *Sphenodon punctatus*.—*And other Papers*.

FRIDAY, JUNE 27.

PHYSICAL SOCIETY, at 5.—Prof. C. L. Fortescue: The Current-Voltage Characteristics of High-Voltage Thermionic Rectifiers.—Prof. Ernest Wilson: The Measurement of Small Susceptibilities by a Portable Instrument.

MONDAY, JUNE 30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Capt. L. B. Turner: The Oscillatory Valve Relay: A Thermionic Trigger Device.

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THURSDAY, JULY 3, 1919.

SIR WILLIAM TURNER.

Sir William Turner, K.C.B., F.R.S., Professor of Anatomy and Principal and Vice-Chancellor of the University of Edinburgh. A Chapter in Medical History. By Dr. A. Logan Turner. Pp. xv+514. (Edinburgh and London: William Blackwood and Sons, 1919.) Price 18*s*. net.

OF all the distinguished men who have passed away during the years of the war, few or none have shown more devotion to, and done greater service for, the institution and the profession to which they belonged than the late Sir William Turner.

The life-history of a man who, without money or influence to facilitate his progress, became demonstrator, professor, principal, and vice-chancellor in a great university, and president of the General Medical Council, is naturally an attractive subject for a biographer, and, provided that the writer of the history has had an intimate acquaintance with his subject and has a thorough appreciation of the circumstances of the period in which the events dealt with took place, the biography is likely to be both interesting and instructive.

Fortunately the conditions have been adequately fulfilled, and Dr. Logan Turner's history of his father's life and of the circumstances of the time in which it was lived shows that he has inherited two at least of his father's characteristics—full grasp of the subject to be dealt with, and the faculty of clear exposition which renders prominent and comprehensive all its chief features.

Sir William Turner was a many-sided man; he was interested in teaching, government, administration, and research; he dealt, therefore, with many problems, and left them all in a clearer position than that in which he found them; but, since his researches commenced in his early days as a teacher and ended only with his life, and as his work as a developer, organiser, and governor extended over the greater part of the time that he was connected with the University of Edinburgh, his many activities in the various spheres overlapped one another to a very large extent. This has been recognised by his biographer, who has dealt with the events of the history, not in strict chronological order, but, to quote his own words, "rather in the form of a series of sections, each more or less complete in itself."

The book commences with an account of the boy, William Turner, following him from Lancaster to London, and from London to Edinburgh; then it touches upon his early difficulties, anxieties, and successes as a demonstrator under Goodsir; afterwards comes the period of work as professor of anatomy, and in that section the author discusses the reasons for the rise and fall of the number of the students in the anatomy class in three decennial periods. The succeeding section deals with Sir William's scientific work, which covered very wide and varied ground, though the greater part of it was in connection with marine mammals and anthropology.

The remaining half of the book is devoted to Sir William's work in the Senatus Academicus; his association with the Medical Act of 1886 and the Universities (Scotland) Act of 1889; the progress and extension of the Medical School of Edinburgh during his periods of office as professor and principal; and it concludes with a summary of his character in relation to his administrative work.

Such a bald outline of the plan on which the biography is written gives no idea of the entrancing history of the times during which the work was done, which the author has made the setting for the life-history of his subject, and into which he has introduced a series of letters which passed between Sir William and the numerous distinguished men with whom he was associated in connection with all the various branches and phases of his work. The letters carry the reader back to 1854, when John Goodsir first wrote to Mr. William Turner, and thence onwards to 1908, and they include several from Charles Darwin which are now published for the first time.

It is possible that the reader will not agree with all the author's opinions and conclusions, but he will be bound to admit that they are fair and tenable, and he will find the book interesting, illuminating, and eminently readable from the beginning to the end.

APPLIED PHYSIOLOGY.

The Physiology of Industrial Organisation and the Re-employment of the Disabled. By Prof. Jules Amar. Translated by Bernard Miall. Edited, with Notes and an Introduction, by Prof. A. F. Stanley Kent. Pp. xxv+371. (London: The Library Press, Ltd. 1918.) Price 30*s*. net.

PROF. AMAR displayed, in the research which formed the subject of his doctoral thesis of 1909, much ingenuity in applying the somewhat difficult technique of indirect calorimetry to the study of human energetics under unfavourable conditions. Later, in various researches which are described in his treatise "Le Moteur humain," the same resourcefulness was manifested; in particular, his measurements of the respiratory metabolism of metal workers deservedly attracted attention to a line of inquiry which was, and is, of considerable practical importance. Since then the French Government has utilised Prof. Amar's talents in a wider field, and the present volume contains a general account of his recent work.

No reader of this book can fail to be impressed by the mental acuteness, mechanical ingenuity, and enthusiasm displayed by its author, particularly, perhaps, in the concluding section, which treats of the re-education of war cripples, expounds the principles of prosthesis, and describes, with numerous diagrams and photographs, a large number of valuable devices.

Had Prof. Amar restricted the scope of his

undertaking to matters with which he is thoroughly familiar, the most censorious critic would have found little to blame; but he has attempted to cover so large a field that the most friendly reader is often reminded of Dr. Johnson's ungallant dictum that a "woman's preaching is like a dog's walking on his hind-legs. It is not done well; but you are surprised to find it done at all." The psychologist will perhaps feel this when confronted with such questions as: "Can it be that thought also constitutes a radio-active phenomenon? Is it evolved from the disappearing cerebral substance by a process as yet inexplicable?" while the physiologist must object to difficult problems of nutrition being summarily and dogmatically decided, the decision being emphasised by such aphorisms as: "The chains of the laboratory must not too closely shackle the limbs of education, for education is a thing which lives and moves."

The general physiological introduction is, in fact, the weakest part of the book, and the method of its presentation in an English edition is, we think, open to criticism. The work is announced as edited, with notes and an introduction, by Prof. Stanley Kent, and on pp. 28–29 a note, containing a mild witticism as to the work of the heart, duly appears. But the editor has not thought it his duty to amplify the citations of literature. Ferrier is cited in a French translation, Hill and Flack in a short French abstract, while a misleading account of the chemical physiology of respiration is allowed to stand without any marginal references to the papers of Haldane, Pembrey, or their pupils. Similarly, the English reader of the section upon the physiological action of alcohol should have been directed to the recent report of the scientific committee appointed by the Central Control Board, a report which modifies some of the inferences likely to be drawn by the general reader from Prof. Amar's statements. The description on pp. 73–75 of indirect calorimetry should have been supplemented by references to some of the recent papers accessible to the English reader; as it stands, it conveys a very inadequate impression of the difficulties of such work.

We have directed attention to these defects because, in the introduction, an appeal is made to a wide circle of readers, and we fear that an erroneous impression of simplicity and finality may be conveyed. In our opinion, the book should have received much closer editorial supervision before being placed in the hands of the general public.

M. G.

THE PROBLEM OF INDIVIDUALITY.

(1) *Conscience and Fanaticism: An Essay in Moral Values.* By George Pitt-Rivers. Pp. xvi+112. (London: Wm. Heinemann, 1919.) Price 6*s.* net.

(2) *The Nature of Being: An Essay in Ontology.* By Henry H. Slesser. Pp. 224. (London: George Allen and Unwin, Ltd., 1919.) Price 10*s.* 6*d.* net.

(3) *Life and Finite Individuality: Two Symposia.* 1. By J. S. Haldane, D'Arcy W. Thompson, P. Chalmers Mitchell, and L. T. Hobhouse. 2. By Bernard Bosanquet, A. S. Pringle-Pattison, G. F. Stout, and Viscount Haldane. Edited for the Aristotelian Society by Prof. H. Wildon Carr. Pp. 194. (London: Williams and Norgate, 1918.) Price 6*s.* net.

WE have been forced by great world events to revise many accepted formulæ and analyse anew many familiar concepts. The period of reconstruction on which the human race seems to have entered is not confined to economic and social relations, and "unrest" is not merely descriptive of the labour world; it extends to the sphere of speculation. In the new order which we feel arising it is easy to see that the predominant interest is the problem of the limits of individuality.

(1) Mr. Pitt-Rivers has given us a study of very great interest and value if we consider, not the erudition or lack of erudition it displays, for it makes no pretence to any, but the special circumstances which have led to its conception and production. A young officer in such leisure as is afforded to him in the intervals between the active operations of campaigning relieves the *ennui* by setting himself the task of studying the curious, and to him irritating, phenomenon, the conscientious objector. He has done it very well. There is a certain lack of co-ordination between the parts of his book, but what we are struck with is the freshness with which one who has responded cheerfully and whole-heartedly to the call of the community views as an intellectual puzzle the case of the man who fanatically rejects that call, even to the extent of incurring ignominy and extreme personal suffering.

(2) Mr. Slesser's "Essay in Ontology" is a much more ambitious effort. It proposes in a very short treatise, divided into easy sections with bold headlines, to settle finally the vexed problem of metaphysics. It regards the enterprise as both simple and easy. To enter the kingdom of philosophy we have only to become as little children. It brings to mind the famous adventure of a professor in the Academy of Laputa, who simplified the task still further by inventing a machine by means of which works of philosophy could be produced without any aid from learning and study.

(3) If anyone wants a corrective to the notion, by no means uncommon, that the problems of philosophy are simple and only require that we shall consent to be disingenuous, he will find it if he will study the second symposium in the Aristotelian Society's supplementary volume. The question discussed from various points of view by Prof. Bosanquet, Prof. Pringle-Pattison, Prof. Stout, and Lord Haldane, "Do finite individuals possess a substantive or an adjectival mode of being?" deals with the problem which presents probably the deepest cleavage in philosophical opinion, not only to-day, but also throughout the modern period. It is a metaphysical and a logical problem. Is reality ultimately monistic, or is it

monadistic? If monadistic, how are the monads related to one another and to God? And, is the unity of knowing and being such that there can be only one ultimate subject of every judgment to which all predication refers?

The first symposium in the volume, "Are physical, biological, and psychological categories irreducible?" is of much narrower range, but of very wide and practical interest from the point of view of scientific method. Dr. J. S. Haldane, in the opening paper, makes a powerful appeal to his special experimental work on the physiology of breathing, and also to his experiments on bleeding and on the action of the kidneys, as conclusively proving the inadequacy of the ordinary mechanistic explanation. His contention is that in vital phenomena the investigation must proceed from function to structure, and never *vice versa*. He rejects the neo-vitalist hypothesis equally with the mechanistic, and proposes a principle which he suggests may be named "organicism," but is really the philosophical principle of personality. The activity of life consists in the maintenance of a normal or constant equilibrium in a continuously disturbing environment, and an organism is a system of interconnected normals. The thesis is criticised from somewhat different points of view in the papers of Prof. D'Arcy Thompson, Dr. Chalmers-Mitchell, and Prof. Hobhouse, but Dr. Haldane is able to claim in his reply that on essential points there is general agreement.

The two symposia have been reprinted from the Aristotelian Society's Proceedings. They cannot fail to be welcome to a great number of students in the convenient form of this independent volume.

OUR BOOKSHELF.

The Science of Labour and its Organisation. By Dr. Josefa Ioteyko. (Efficiency Books.) Pp. viii + 199. (London: George Routledge and Sons, Ltd., 1919.) Price 3*s.* 6*d.* net.

IN this little book Dr. Ioteyko treats of the human motor and the measurement of industrial fatigue, scientific management, measurement of aptitudes, anthropological comparison of the sexes from the point of view of strength and endurance, alimentation and work, re-education of the left hand for the mutilated, and Belgian methods of technical education and the University of Labour.

The earlier part of the book consists largely of material gleaned from different authors, and not always very skilfully strung together. Much important work remains unnoticed, and the treatment, as a whole, is inadequate. If the intention was to write an elementary book for the use of beginners, a different style and simpler language might well have been employed. If it was to produce a volume useful to those already acquainted with the subject, a more exhaustive treatment would have been suitable.

The need has passed for small books written merely to attract attention to the importance of the matter. The study of the organisation of labour is entering on a new phase, and requires a new treatment. There are persons sufficiently learned in the subject to assume the *rôle* of teachers, and it is to be hoped they will soon find time to make the learning they possess available for all those who desire to pursue the matter in the light of modern knowledge.

This book is one of Messrs. Routledge's "Efficiency" series, and we naturally looked for internal evidence of efficiency in it, but we must confess to some disappointment at the occasional use of words to express an English idea whereby the meaning is obscured. For instance, on p. 55, where it is stated that "a man should be required *to load* during a strictly defined time," a completely wrong idea is given of Taylor's meaning.

Typographical errors are met with frequently, and, though these may perhaps be viewed leniently in existing circumstances, one cannot help feeling that the exercise of a little care would have led to their elimination.

For the rest, the book is evidence of the interest that is taken in an important subject, and we welcome it accordingly.

Army Gardens in France, Belgium, and Occupied German Territory. Their Making and Management, with Plans and Directions suited to the Garden Service of the British and American Expeditionary Forces. By Georges Truffaut, with the collaboration of Helen Colt. Pp. 65. (Versailles: Œuvre des Pépinières Nationales du Touring-Club de France, 1919.)

THIS booklet, which has been drawn up by M. Georges Truffaut, Director-General of Army Gardens on the French Front, is a very interesting record of a remarkable piece of work, which has been of immense service to the armies in France. During the past two years 7000 vegetable gardens have been established in the actual war zone behind the French front, and, in addition, large national nurseries for vegetable plants have been formed at Versailles. Fifty-six other nurseries for raising seedling vegetables for gardens near the front have also been established, and during 1918 some 200,000,000 seedling vegetables were distributed. Tables of vegetable rationing and full details of the cultivation and cropping of the gardens are given, also particulars as to the arrangement of the gardens, manuring, and other cultural matters.

The value of the publication is heightened by the illustrations of the huge nursery of about 70 acres at Versailles, of some of the smaller nurseries at Champigneulles and Baccarat, and of some of the Army gardens. A list of the vegetables suitable for cultivation, with their seasons and other particulars, is given, and also plans for the planting of a given area of ground.

Though, happily, the immediate military need of the gardens and nurseries has come to an end, the results achieved are by no means lost, as the work done by M. Truffaut and his staff should have far-reaching effects not only in France, but also in this country.

The Peace Conference Atlas. A Series of Maps to Illustrate Boundary and Other Questions under Consideration at the Peace Conference, 1919. Maps 24. (London: Edward Stanford, Ltd., n.d.) Price 5*s.*

THIS small atlas is not designed specially to illustrate the Peace Treaties, but rather the problems which faced the Peace Conference. It should prove useful in studying the vexed problems of European racial and national boundaries. The maps are black and white, with the boundaries, as in 1914, in red, and a red wash used in many cases to indicate areas of speech. Presumably the dividing line is taken at a bare majority, but this is not stated, and in any case we fear that such simplification of Eastern European problems as these clear-cut maps suggest is outside the scope of practical statesmanship. In comparing the maps showing Italian speech and the boundaries of Yugo-Slavia we note some discrepancies, but on the whole the maps are carefully prepared and well printed. The larger scale maps deal chiefly with Eastern Europe, but the late African and Pacific possessions of Germany are not omitted.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Dr. Kammerer's Testimony to the Inheritance of Acquired Characters.

PROF. MACBRIDE's letter in NATURE for May 22 last calls for some statement from me. When, in 1910, I was engaged in writing those chapters of my book, "Problems of Genetics" (1913), which deal with the effects of changed conditions in producing genetic variation, I endeavoured to form an opinion as to the validity of the cases usually claimed in recent years as having given positive results. I had no difficulty in showing that nearly all this evidence is unsubstantial. The copious and astonishing observations said to have been witnessed by Prof. Tower, of Chicago University, and by Dr. Kammerer, of the Vienna Versuchsanstalt, naturally called for exceptionally careful examination. The results of both these authors had been very widely accepted, and had begun to pass current in the text-books. In the case of Prof. Tower's paper, as I demonstrated in my book, close textual criticism revealed features which suggested that implicit confidence should be postponed pending confirmation—a conclusion to which I had already come when, on a visit to Chicago in 1907, I had seen illustrative specimens which Prof. Tower was good enough to show me. Prof. Tower's results are still quoted (*e.g.* by Babcock and Clausen in their recent text-book, 1918), but we have for some years awaited fresh light on the facts or any explanation of the difficulties to which I directed attention.

In the case of Dr. Kammerer's statements, most were plainly incapable of ready verification. The instance of Alytes was the most favourable for this purpose, inasmuch as the males with the horny pads, said to have been produced in response to changed conditions, could be easily preserved. So, no doubt, might the Salamanders, of which the "*sattsam bekannte*" history, as Prof. Baur calls it, has been published in numerous German periodicals; but there was this difference: that whereas Salamanders corresponding with Dr. Kammerer's several patterns can be had from the dealers, students of the Batrachia are, I understand, agreed that Alytes with Brunftschwielen does not exist in Nature. I therefore wrote from Cambridge (July 17, 1910) to Dr. Kammerer asking for the loan of a demonstrative specimen, promising to examine it with every care and to return it in due course. He replied in English (July 22) that he was on a holiday, continuing: "As soon as I shall be returned to my usual work—two congresses and a journey to Munich are still between—I will send to you any objects you may need for your book and have interest for, with the greatest pleasure! I hope that it will not be too late then for using them in the chapter, 'Effects of External Conditions,' of your future book.

"I am not quite sure whether I killed already specimens of Alytes with 'Brunftschwielen' or am possessing only living males of this (F_4) generation.

"But I do not doubt that also other objects are well fitted to show easily the effect of conditions and their inheritance. Especially my new experiments on influence of soil, etc., upon colours (not yet published, except some preliminary notes; for instance, in the *Verh. Deut. Naturforscher u. Aerzte,* Salzburg, 1909) are much more favourable for that purpose than the instinct variations, in spite of their morphological consequences.

"I have also promised (*i.e.* Dr. Przibram has in my name) to Mr. Doncaster to spare him a series of tadpoles with alterations, etc., for your museum; and it is my intention to fulfil this promise, together with that given to you in my present letter during the beginning of this autumn." Nevertheless, neither I nor the Cambridge Museum (as Dr. Doncaster tells me) ever received any of the promised material.

Later in the summer of 1910 I unexpectedly was able to attend the *Mendelfeier* at Brünn, and was for some time in Vienna, having the privilege of being the guest of my old friend Dr. Przibram. I was many times at the Versuchsanstalt, and inquired in vain for the Alytes. On one occasion especially, about October 3 or 4, I was there in company with Profs. E. Baur, Lotsy, Nilsson-Ehle, Dr. Hagedoorn, and the late M. Ph. de Vilmorin. Those who survive of that party will remember that, on conferring together, we all shared the same feeling of doubt. After seeing what Dr. Kammerer showed us we were entirely unconvinced, and in particular it seemed to us inexplicable that, if Alytes had existed with Brunftschwielen in July, one specimen of so great a curiosity should not have been preserved, if only for exhibition with the Salamanders at Dr. Kammerer's numerous lectures. I may add that I expressed my doubts categorically to Dr. Przibram, the head of the Anstalt, but I am glad to think that, though he defended Dr. Kammerer, our cordial intercourse continued unbroken up to the time of the war. Few, I imagine, will now consider that, on the evidence available, my scepticism was not justified. (For an elaborate and destructive criticism of Dr. Kammerer's statements, see Boulenger, G. A., *Ann. and Mag.*, August, 1917, p. 173).

After reading Dr. Kammerer's new paper I agree with Prof. MacBride that a fresh inquiry is desirable. The two photographs, Taf. x., Figs. 1 and 2, which he accepts as proof of Dr. Kammerer's observation, present some very curious features, and I feel much curiosity concerning them. It is, of course, on Fig. 2

that the case rests. This photograph, said to be the work of Prof. E. D. Congdon, of Harvard, is extraordinarily bad. It represents a Batrachian lying on its back, seen from in front. Were we not told that it is Alytes, the fact could not have been ascertained, for all but the hands is a blur. The hands are seen from their dorsal surfaces. On the radial side of the *wrist* of the right hand is a lump which Dr. Kammerer claims as a Brunftschwiele. The phalanges of the thumb, as Dr. Kammerer expressly declares, are unmodified in this specimen, and no *Schwielen* are visible on the left arm or hand at all. Though on analogy with other genera *Schwielen* might well occur on the wrist or forearm, the proposition which Fig. 2 is intended to support is not that set forth in the original paper which I criticised (*cf.* especially *Arch. Entwm.* 1909, xxviii. Taf. xvi., where a modified *thumb* is vaguely represented). In the text of the present paper we are told that the *Schwielen* are very variable in position and extent. *I do not, however, find any mention of modification in digit iv.* This finger is, of course, external, and could scarcely function in the embrace; nevertheless, the *outer* side of digit iv. is most conspicuously thickened in the right hand of the animal shown in Fig. 2. So striking is this appearance that everyone to whom I have shown the figure at first sight supposes this thickening to be the *Schwiele* illustrated. I myself, on looking at the picture before reading the details, had no doubt that this was the *Daumen* with its excrescence, the hand being thus supposed to present a palmar view. Dr. Boulenger at once pointed out to me that this interpretation was impossible, for the reason, among others, that the comparative lengths of the digits proved the hand to be shown in dorsal view, and that the modified digit is iv. It must be remembered that the photograph is so indistinct that much is left to the imagination.

The peculiarity of the right digit iv. would be still more manifest if Fig. 1, which gives a normal Alytes, were a genuine photograph. It has, however, been so clumsily painted up that the extremities are not like those of any animal. Each finger and toe has a painted outline, not always in the right place, and only on comparison with actual specimens can the full extent of the modification in digit iv. of Fig. 2 be appreciated. As it stands, this digit is very like the *Daumen* of the original figure. I will not yet venture on a positive interpretation, but I may remark that what the new evidence suggests is that these modifications, whatever they may be, and to whatever cause they may be due, can also appear on the outside of digit iv.

I find it difficult to understand why, if these structures are as Dr. Kammerer declares, he did not make a proper series of photomicrographs of them *in situ*, showing their several positions and forms—no very hard task for such an institution as the Versuchsanstalt. Entomologists and students of fungi make such photographs constantly. Even one good ordinary photograph or drawing would have shown more than the ambiguous pictures now offered us. If anyone wishes to see how Alytes looks in a good photograph, he should turn to Boulenger (*Bull. Ac. Roy. Belg.*, 1912, p. 573). The latest of Dr. Kammerer's figures dates from July, 1913. A long series of *Arch. Entwm.* has been published during the years of the war, often with magnificent plates. Dr. Kammerer does not state how many modified Alytes he has had, but by implication they have been numerous. If, on second thoughts, he was unwilling to send one to England, could he have resisted the temptation to send one to the Berlin Museum to be shown to Prof. Baur, and so confound him and other sceptics? Three years had elapsed since we openly expressed our disbelief, but I know that up to January, 1914, no such specimen had been sent.

Prof. MacBride urges that sceptics should repeat experiments on the inheritance of acquired characters. We, however, are likely to leave that task to those who regard it as a promising line of inquiry. Why do workers in that field so rarely follow up the claims of their predecessors? Each starts a new hare. Scarcely has one of their observations been repeated and confirmed in such a way that we could be sure of witnessing the alleged transmission if we were to try for ourselves. Brown-Séquard's observation on guinea-pigs is an exception. That has been repeated by various observers, until at length, by the work of Graham Brown, the mystery may be regarded as explained. The observation was true, but the interpretation was faulty. As I have often remarked, acquaintance with the normal course of heredity is an indispensable preliminary, without which no one can interpret the supposed effects of disturbance. This knowledge of normal genetic physiology is being slowly acquired, and already we have enough to show that several variations formerly attributed to changed conditions should not be so interpreted. Even in this case of Alytes, were a male with incontrovertible Brunftschwielen before our eyes, though confidence in Dr. Kammerer's statements would be greatly strengthened, the question of interpretation would remain, pending the acquisition of a knowledge of Batrachian genetics.

W. BATESON.

June 22.

The Food of Rats.

IN NATURE of September 19, 1918 (vol. cii., p. 53) a summary is given of an article by Prof. P. Chavigny on the food of rats. Some of the statements in this article appear to me to be extraordinary, particularly the alleged necessity for rats to get cooked human food. The hordes of rats which swarm along our foreshores, and in granaries and like places, could not possibly get sufficient cooked human food to keep them alive, yet they are plump and well-fed. Anyone who has kept fowls or ducks in a rat-infested place knows that rats will carry off and devour chicks and ducklings, even dragging them from under the brooding mother, eating them raw. Attacks on living and dead human beings and smaller animals are by no means rare. Along the water-front rats freely catch and eat crabs, and they will devour raw fish with avidity.

Certainly rats will eat cooked food when they can get it, but they are omnivorous feeders, and I have personally known them not merely to gnaw, but to devour pumpkin, melon, apple, and other fruits. Of pumpkin-seeds they are very fond, and an apple-core makes a good bait for a trap. They do not seem to care much for raw beef; I have noticed them attack raw potatoes and pumpkin-seeds, neglecting raw steak which was lying alongside. Under a creeper in my garden near Sydney the common snail (*H. aspera*) was very abundant, and *M. decumanus* used to devour large quantities; the apex of the shell was always bitten off so that the mollusc could be readily extracted. On the Upper Waikato River, New Zealand, the same rat dives into the water and gathers the fresh-water Unio. On the river-banks the shells are gnawed open and the animal eaten. The shells are always bitten through at the same spot of one valve, but I forget now whether that was the right or left one.

In Australia at certain seasons a "cutworm" moth, known as the "bogong" or "bugong" (*Agrotis infusa*), swarms in myriads in many places, and is,

after the wings have been singed in a charcoal fire, used as an article of food by the aboriginals. These moths sometimes invade the cities and crowd into houses and stores for the sake of darkness. At Melbourne, in a large sugar store, I have noticed *M. decumanus* collect the moths and eat the bodies, rejecting the wings.

There came under my notice lately at Pennant Hills, near Sydney, a case of a curious article of food for a rat. A rat gained access to the laundry attached to my house, and for some weeks it used to drag pieces of common soap behind any shelter and devour them. That the soap was really eaten was evident, because no particles were left lying about. Ultimately I succeeded in trapping the rat, which was a half-grown male, *M. decumanus*. An empty spring trap was placed open in a box having an opening just over the jaws. A piece of tissue-paper was arranged over the jaws and the whole covered with a thin layer of bran, a bait being laid at the far end of the box. On examination I found the intestines empty and the stomach gorged with fresh bran, which the rat had scooped up before entering the trap. Although I searched carefully I could never find any means of exit from the laundry or see the rat, but I presume it must have got other food somewhere, for absolutely nothing edible was ever placed in the laundry. The rats' excreta were always quite normal.

THOS. STEEL.

Sydney, April 28.

SOME RECENT ATOMIC WEIGHT DETERMINATIONS.

THE story, adequately told, of the evolution of ideas and the development of knowledge concerning the stoichiometrical constants we term atomic weights forms a most interesting chapter in the history of the philosophy of chemistry. In point of time it would extend over no very long span. There are men living who are personally cognisant of its most important phases, and some of them in early life were acquainted with others who may be said to have connected their own epoch with that of those who witnessed the beginning of experimental efforts to obtain quantitative estimations of their values.

The formulation of the laws of chemical combination involved the necessity for exact knowledge of the relative weights with which substances enter into such combination, and, as is well known, Dalton himself made tentative trials to obtain some definite conception of their measure. But Dalton was not a particularly skilful or accurate experimenter; his apparatus and methods of quantitative work were very crude and even below the standard of his time. This was fully recognised by his contemporaries, particularly by Berzelius, who may be said to have been the first to attempt precise determinations of atomic weights. The work of Berzelius and his coadjutors marks, in fact, an epoch in the history of the subject.

Of course, as is now well understood, the germ of Dalton's ideas, although he probably was unconscious of it, is to be found in the work of his predecessors, but it does not seem to be generally known that Cavendish, in effect, postulated and put into practice the fundamental conceptions expressed in the laws of constant, multiple, and reciprocal proportions. He appears to have convinced himself years before the time of Proust and Berthollet that the same substance is invariably composed of the same elements united in the same proportion, and, as can be shown from his published writings, he made quantitative analyses on the implicit assumption of the other laws. This was first pointed out by George Wilson, and has been more fully developed in the course of a critical examination of Cavendish's memoirs in the Phil. Trans. for 1786 and 1788 on "Freezing Mixtures," contained in an annotated edition of his complete papers, published and unpublished, which it is to be hoped the Cambridge University Press may soon be in a position to issue.

It would occupy more space than is available to attempt to trace the several phases, which, like milestones, mark successive stages in the progress and development of knowledge concerning atomic weights, nor is it necessary to set out in detail the various reasons which have led chemists to recognise the imperative necessity of knowing these constants with the highest attainable precision. Philosophers like Berzelius always desired the utmost accuracy in the abstract interests of truth. But, to begin with, the only practical use of atomic weights, or combining proportions as they were called by Davy, was in quantitative efforts to elucidate the chemical composition of substances, and, considering the imperfections of quantitative methods, an approximation to exactitude sufficed. When substances began to be bought and sold on the results of analysis, atomic weights became of importance in commercial transactions, but even then, for the purpose of trade, no very high degree of accuracy was required. Even the numbers of Berzelius's time sufficed for the determination of exact formulæ, and enabled the nature and progress of a chemical change to be traced with precision.

But in recent time, and with the development of chemical theory, atomic weights have acquired a wider importance and a new significance, and a much higher degree of accuracy is demanded. It is, in fact, almost useless to discuss certain questions unless these constants have been rigorously determined. Very much now depends upon little differences—the little difference, indeed, frequently makes all the difference. But, unless this is established with reasonable certainty, it is a waste of time to base an argument upon it. We thus enter upon another and the latest phase in the development of the subject.

For this new departure, which may be said to start with Stas, the chemical world is greatly indebted to American chemists, such as J. P. Cooke and his colleagues, Oliver Huntington and Theodore Williams; and to J. W. Mallet, Morley, and Noyes. Prof. Theodore Williams has worthily maintained the traditions of the Harvard school, and it is largely to his work and example that the present high standard has been reached. We

owe to him in great measure the enormous improvement in technique which distinguishes modern determinative work of this kind. Such work will not pass muster to-day unless it is performed with the scrupulous regard to detail and conscientious search for causes of error and for means to avoid them which characterise the determinations he has directed.

America, moreover, is to be congratulated in possessing a publishing agency like the Carnegie Institution of Washington, which undertakes the printing and distribution of important scientific memoirs which might seriously tax the means of most scientific societies, and which, on account of their specialised character, no ordinary publisher would be likely to accept as a business proposition.

A recent publication by the Carnegie Institution is concerned with the results of a determination of the atomic weights of boron and fluorine by Messrs. Edgar F. Smith and Walter K. van Haagen.[1] As it presents some features of general interest, an account of the work may not be unacceptable.

The redetermination of the atomic weight of boron has revealed the unexpected fact that the value for this constant hitherto accepted is at least 1 per cent. too high—a remarkable circumstance, all things considered. Boron, of course, is a common and widely distributed element, and the estimation of its atomic weight has been made by at least half-a-dozen experimenters since the time of Berzelius with such concordant results that it might be assumed that it was fairly well known. But there are certain considerations connected with these determinations which might occasion doubt. To begin with, there is no great choice of methods in this particular case of a sufficiently valid character upon which to base determinations. Practically all the numbers depend upon the analysis of borax, either hydrated or anhydrous. We have here an instance of what has been frequently deprecated in atomic weight work. A determination based upon the amount of water in a hydrated salt rests upon a faulty principle. It presupposes that the amount of water in a hydrated salt is absolutely definite and constant, and that adventitious water can be separated from that which is supposed to be normal to the constitution of the salt, of which there is no absolute proof. It further assumes that the salt can be completely dehydrated under the particular conditions of the experiment, which may or may not be the case. Now, as all the previous determinations of the atomic weight of boron rest upon practically the same basis, they may involve the same fortuitous errors, and Messrs. Smith and van Haagen's investigation shows that, as a matter of fact, they do. The substantial uniformity of the previous results is therefore misleading. It is a recognised canon in atomic weight work that a value can be accepted with confidence only if it is based upon methods involving different principles and modes of manipulation free from known sources of error. In these analyses of borax the manipulative processes were of the simplest possible character, and of themselves not liable to introduce error if properly conducted. The main error is traceable to the water and to an imperfect knowledge of the conditions under which the borax could be completely dehydrated.

The persistent retention of water by substances, even when exposed to high temperatures, is, of course, no new fact, and many instances might be given of it. No rational explanation of the phenomenon is known. In the case of borax Messrs. Smith and van Haagen offer an explanation which has at least the merit of ingenuity, if not of generality. In effect it is as follows: When the hydrated salt is heated the water of crystallisation is evolved, and at first passes through the liquid state before escaping as steam, forming droplets of an aqueous solution of borax, which is then hydrolysed as follows:—

$$Na_2B_4O_7 + H_2O \rightleftarrows 2NaBO_2 + 2HBO_2$$
$$Na_2B_4O_7 + 3H_2O \rightleftarrows 2NaOH + 4HBO_2.$$

This process is known to occur in weak aqueous solutions of borax. The sodium metaborate and hydroxide on concentration slowly recombine with the boric acid, reforming borax. It may be that on heating the borax the expulsion of water takes place more rapidly than the recombination of base and acid, and therefore heated borax may contain more or less sodium metaborate or hydroxide and free boric acid, and that the recombination is only complete after prolonged fusion.

"According to this view," say the authors, "the last traces of water expelled from fused borax are not merely the last portions of the water of crystallisation proper, but are to be looked upon as water of neutralisation, resulting from the recombination of sodium metaborate (or hydroxide) with boric acid, both of which were produced by a transient hydrolysis during the earlier stages in the dehydration; and this view explains why the last traces of water should be removed with greater difficulty than the bulk. Hence the final loss of water in the dehydration of borax may in all probability be due to the completion of such reactions as the following:—

$$2NaBO_2 + 2HBO_2 = Na_2B_4O_7 + H_2O$$
$$2NaOH + 4HBO_2 = Na_2B_4O_7 + 3H_2O."$$

In support of this hypothesis the authors point to other instances in which salts which are extensively hydrolysed in solution retain the last traces of water with great tenacity. There are, however, cases to which this reasoning scarcely applies. Indeed, even in the particular instance of borax the authors point out that it is not necessary to assume this hydrolytic action. Borax in a state of fusion may dissociate into sodium metaborate and boric anhydride:—

$$Na_2B_4O_7 \rightleftarrows 2NaBO_2 + B_2O_3.$$

This dissociation may begin before the water is completely expelled, and the hygroscopic boric

[1] "The Atomic Weights of Boron and Fluorine." By Edgar F. Smith and Walter K. van Haagen. (Washington: The Carnegie Institution of Washington, 1918.)

anhydride may combine with this water and so retard the final dehydration.

But, whatever may be the true explanation, it cannot be doubted that this obstinate retention by heated, and even fused, borax of about 0·2 per cent. of water is the main cause of error in all previous attempts to determine the atomic weight of boron by means of this salt. That the complete dehydration of borax is difficult was recognised by Dobrovolsky so far back as 1869, and was known to Hoskyns Abrahall, who concluded that the dehydration of borax was untrustworthy for ascertaining an atomic weight ratio.

In 1893 the late Sir William Ramsay and Miss Emily Aston published the results of a redetermination of the atomic weight of boron which appeared to them to confirm the commonly accepted value of 11·0. Their methods consisted (1) in ascertaining the water of crystallisation in borax, and (2) in converting dehydrated borax into sodium chloride by repeated distillation with hydrochloric acid and methyl alcohol, according to the process of Gooch and Rosenbladt. All the weighings are given in their paper to seven places of decimals—an assumption of precision scarcely warranted by the circumstances, and an instance of what Kopp was wont to call *Decimalspielerei.* The results of the first method varied from 11·04 to 10·85; the mean value adopted was 10·921. Two series were made by the distillation method; the first gave values varying between 11·015 and 10·879: adopted mean = 10·952; in the second the extreme values were 10·992 and 10·936: adopted mean 10·966. In the last series the amount of chlorine in the common salt was determined by gravimetric analysis in the usual way, which afforded a new ratio. The numbers thus obtained were uniformly above 11 (11·003–11·091: adopted mean 11·052).

The details given by Ramsay and Aston permit of a discussion of their observations in the light of the facts obtained by Messrs. Smith and van Haagen, and it is satisfactory to find that the two sets of observations can be brought into complete harmony. Indeed, certain inconsistencies among the results of the English observers, on which they themselves commented, but were unable to explain, are now cleared up, and serve to corroborate the results of the American chemists.

The recalculation of Ramsay and Aston's experimental numbers by means of the best-determined ratio of AgCl : NaCl shows that the inconsistency referred to becomes slightly greater. From the weight of NaCl, B = 10·951; from that of AgCl, B = 11·061, or a difference of fully 1 per cent. Now the method which they adopted to dehydrate borax combined with their low value for the density of vitreous borax—2·29, as against the proper value, 2·357—makes it practically certain that the fused borax still contained approximately 0·3 per cent. of water, and that the sodium chloride, although heated to 350°, still retained water the amount of which may be computed from the ratios. It was 0·214 per cent. By introducing these corrections, which are not arbitrary, but fully warranted by the facts, Ramsay and Aston's first series leads to the value B = 10·901, and their second series to B = 10·909. They agree, therefore, among themselves, and are in conformity with the result of 10·900 obtained by Messrs. Smith and van Haagen.

As regards the new determination of the atomic weight of fluorine, it must suffice to say that it depends on the ratios of sodium fluoride to sodium borate and sulphate, and on a cross-ratio between sodium chloride and sodium fluoride. Eight determinations varying between 19·002 and 19·008 gave F = 19·005, which completely confirms the present international value.

T. E. Thorpe.

THE PEACE TREATY AND MINERAL FIELDS.

The Treaty of Peace has taken into account the economic relations of the contracting parties and the effect upon these of the peace conditions to a degree that has never been approached in any previous document of the kind. It is not too much to say that, whereas all previous peace treaties have been essentially diplomatic, the present one is essentially industrial in its outlook. The only mineral rights specifically referred to are those involved in the cession of the coal basin of the Sarre to France; it is difficult to understand, by the way, why, in the published English version of the treaty, the German spelling of the name has been used instead of the French. This cession bulks very large in the Treaty, but is of far less importance than would appear at first sight. It is estimated that the total quantity of coal contained in the Sarre basin is only 5·7 per cent. of the total quantity owned by Germany, so that the loss to Germany in respect of coal reserves is insignificant. From the point of view of annual output, it is somewhat more important; Germany produced in 1913 about 191½ million tons of bituminous coal, out of which the Sarre district produced about 14 millions, or rather more than 7 per cent. On the other hand, the possession of this coal-field means a great deal to France.

Before the war the total coal output of France was about 42½ million tons, so that the Sarre coal-field will increase the ultimate producing capacity by about 33 per cent. Of the total production nearly 22 million tons came from the Pas-de-Calais district, whilst the Nord district produced nearly 8 millions—about 70 per cent. of the entire production. These two districts have been almost wholly wrecked by the Germans; owing to the configuration of this coal-field, in which the coal-measures are overlain by Secondary, highly water-bearing strata, it was easy to do very serious damage by merely blowing in the watertight shaft linings and thus drowning out the pits; owing, further, to the fact that many of the more important collieries are connected by drifts with each other, recovering merely a few of the shafts or even sinking new ones will not suffice, and practically all the old

shafts will have to be re-lined before production on any reasonable scale of output can be commenced. It cannot be hoped to do this in less than five years.

The Peace Treaty provides that due diligence shall be exercised in the restoration of these mines, but that Germany shall make up any deficiency in French coal output from these areas for ten years, the quantity to be thus delivered not to exceed 20 million tons annually for the first five years, and 8 million tons annually for the next five years. Furthermore, Germany is to supply France with 7 million tons a year for ten years, $4\frac{1}{2}$ to $8\frac{1}{2}$ million tons yearly to Italy, and a certain quantity also to Luxembourg. At the most, however, Germany will not have to provide more than about 32 to 35 million tons a year, or about one-fifth of the output left after the Sarre basin has been handed over. The price to be paid for this coal is to be the German pithead price, provided that such price does not exceed the British pithead price for export coal. Thus, incidentally, the Sankey award has had the result of enabling the Germans to charge our Allies 4*s.* 6*d.* per ton more for coal than they would otherwise have been able to do.

It is possible that Germany may lose a certain amount of her Silesian coal to Poland, but it seems clear that at the worst Germany will retain more than two-thirds of her coal reserves, and, as these were originally about two and a half times our own reserves, and more than half the total coal of all Europe, she is not seriously weakened in this respect, although France is undoubtedly strengthened.

No other minerals are specified in the Peace Treaty, but it is well known that the restoration to France of Alsace and Lorraine will have a profound effect in many respects. First of all France re-enters into possession of the whole of the Lorraine iron-ore fields; the vast deposit of "minette" thus becomes wholly French, with the exception of a small amount within the frontiers of Luxembourg, and, now that the latter country ceases to form part of the German Zollverein, it may be hoped that this ore will be diverted to Belgium, where it ought to go. Before the war Germany produced from the conquered province of Lorraine about 21 million tons of iron ore, or about three-fourths of its total output, so that the loss of Lorraine is for Germany an extremely serious matter. On the other hand, France is tolerably rich in iron ores, and the additional quantity of which she resumes possession will not matter to her very much, except for the fact that she can dispose of her surplus to other nations. Above all, the cardinal fact, which makes for world-peace more than would a dozen Leagues of Nations, is that Germany has no longer the iron-ore supplies with which to manufacture the immense stores of munitions which she would need if she were to commence the next war of which a certain section of Germans is already talking.

Another important point, equally well known, is that, with the rich potash deposits of Alsace in French hands, the German potash monopoly is broken, and the rest of the world is no longer bound to come to her for that important product. Thus it may be said that Germany has lost a large slice of her mineral assets; to maintain her position will need all the industry of her hard-working population, and it is more than ever clear to-day, with the Peace Treaty before us, that the future belongs to that nation which chooses to put in most real, steady, hard work for the next ten years.

H. L.

NOTES.

WE announce with profound regret that Lord Rayleigh, whose achievements in many fields of scientific research are familiar to all men of science, and esteemed throughout the world, died on June 30 at seventy-six years of age.

WE record with devout gratitude that the Treaty of Peace between the Allied and Associated Powers and Germany was signed at Versailles on Saturday last, June 28, thus bringing to a close a struggle in which the leading nations of the civilised world have been engaged for a period of nearly five years. The German delegates, in a statement to the Press, declare that they have signed the Treaty without any reservations whatsoever and in the honest intention of carrying out its provisions. They hope, however, that the Entente may in time modify some of the conditions. The return of peace has given rise to great rejoicing throughout the United Kingdom, and in the following message the King expresses the feeling of the people:—"The signing of the Treaty of Peace will be received with deep thankfulness throughout the British Empire. This formal act brings to its concluding stages the terrible war which has devastated Europe and distracted the world. It manifests the victory of the ideals of freedom and liberty, for which we have made untold sacrifices. I share my people's joy and thanksgiving, and earnestly pray that the coming years of peace may bring to them ever-increasing happiness and prosperity." Sunday next has been appointed by Royal proclamation as the day of general thanksgiving, and Saturday, July 19, will be devoted to national rejoicings.

FOLLOWING quickly on the Atlantic flight by heavier-than-air machines, a Service venture, under the control of the Air Ministry, is being made by R34, a machine lighter than air. This airship left East Fortune, Scotland, for Long Island, New York, in the early hours of Wednesday morning, with six officers and 20 N.C.O.'s and airmen, under the command of Major G. H. Scott, and also three officers travelling as passengers. The return journey was to be commenced in a few hours, after replenishing supplies. The distance to a destination near New York is approximately 3000 nautical miles. There will be no attempt to follow a direct route, but the airship will be navigated to secure the best weather conditions and to avoid unfavourable conditions. If the weather proves unfavourable to a westerly crossing, the ship will return to her base in the British Isles. There is a meteorological officer on board who will chart information received by wireless through the Air Ministry. An interesting discussion of the geostrophic winds or gradient winds for June, which give the air-flow practically at about 1000 ft. elevation over parts of the North Atlantic, has been made by

the Meteorological Office. At 50° N. and 25° W. daily observations for twenty-eight years in June show that westerly and south-westerly winds greatly predominate, whilst easterly winds are rare. Similar conditions are shown in 50° N. and 40° W., but northwesterly winds are more frequent than further to the eastward. Wireless reports for several days past published by the Meteorological Office show a great amount of northerly wind, moderate to strong in force, ranging from 10 to 30 nautical miles an hour, and fair weather with a good deal of cloud over the eastern portion of the North Atlantic. Probably better progress would be made in proximity to the 40th parallel than by following the Great Circle track, as lighter head-winds would be experienced on the outward passage.

On the motion for the third reading of the Dogs Protection Bill in the House of Commons on June 27, its rejection was moved by Sir Watson Cheyne and seconded by Sir Philip Magnus. The ground on which this amendment was based was the "unnecessary and vexatious obstacle to medical research" that would be imposed by it, the delay involved in additional certificates being frequently a matter of great importance. The Minister of Health (Dr. Addison) concurred in this view, and pointed out that there was no breach of faith on the part of the Government in reconsidering its amendment passed at the Report stage. He held that Parliament had no right to stop or needlessly to embarrass such research work as that on rickets. The Bill was rejected, the voting being 62 for the third reading, 101 against.

Sir Norman Lockyer has been elected an associate of the Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique in the section of mathematical and physical sciences.

The death is announced, on June 27, of Dr. R. Dancer Purefoy, past president of the Royal College of Surgeons, Ireland, and a member of the Royal Irish Academy and the Royal Dublin Society.

Sir John Tweedy has been asked to deliver the first Thomas Vicary lecture (on anatomy and surgery, instituted by the Barbers' Company) to the Royal College of Surgeons of England. Prof. Elliot Smith and Dr. F. Wood Jones have been appointed by the college Arris and Gale lecturers.

The death is announced, on July 1, in his seventy-eighth year, of Sir John T. Brunner, Bart., the well-known chemical manufacturer, who was associated with the late Dr. Ludwig Mond in the foundation of the alkali works of Brunner, Mond, and Co. around Northwich, which are now among the largest of their kind in the world.

A series of earthquake shocks caused much injury and loss of life in the districts of Florence and Bologna on June 29. The Exchange Telegraph Co. reports that the Ximenian Observatory at Florence has been greatly damaged; and Father G. Alfani, director of the observatory, states that the shocks are the worst which have been experienced in Italy since 1895.

It is announced in *Science* that the seismological library of Count F. de Montessus de Ballore, director of the Seismological Service of Chile, has recently been purchased by Dr. J. C. Branner and presented to Stanford University. This is probably one of the most complete collections of seismological literature in existence, and it is accompanied by a manuscript catalogue containing nearly 5000 titles.

The council of the Royal Society of Arts has awarded the society's silver medal for the following papers read before the society during the past session:—E. C. de Segundo, The Removal of the Residual Fibres from Cotton-seed, and their Value for Non-textile Purposes; Sir Frank Heath, The Government and the Organisation of Scientific Research; W. L. Lorkin, Electric Welding and its Applications; W. N. Boase, Flax: Cultivation, Preparation, Spinning, and Weaving; Lord Montagu of Beaulieu, Aviation as affecting India; and Prof. J. C. McLennan, Science and Industry in Canada.

The Imperial War Conference, after considering the report of a committee of which Sir James Stevenson, Bart., was chairman, made a recommendation in favour of the constitution of an Imperial Mineral Resources Bureau. This body has now been set up and charged with the duties of collecting information regarding the mineral resources and metal requirements of the Empire, and of advising the various Governments and others concerned from time to time what action might appear to be desirable to enable those resources to be developed and made available to meet the requirements of the Empire. The Governors of the Bureau have been appointed, one by the Home Government (the representative of which is the chairman of the Bureau), one by each of the five self-governing Dominions, one each by the Government of India and the Secretary of State for the Colonies, with six representatives of the mineral, mining, and metal industries appointed by the Minister of Reconstruction after consultation with the principal institutes and institutions representing those industries. The Governors have now received their charter of incorporation, and are engaged in putting into effect their scheme of organisation In order that the Bureau may be able successfully to discharge its functions and issue information of an up-to-date character, the Governors are seeking the closest co-operation and assistance of the various Government Departments, scientific institutions, societies, and other bodies with which the Bureau hopes to be associated. The offices of the Bureau are at 14 Great Smith Street, Westminster, S.W.1, and all communications should be addressed to the secretary.

A reprint has recently been issued in booklet form of the article entitled "Patent Law and the Legal Standard of Novelty," first published in the *Engineer* for April 11 last. "Historicus," the author of the article, directs attention to the fact that it was owing to a blunder committed by the Courts in the eighteenth century that the legal standard of novelty was raised from that of the practice of the art to that of absolute novelty within the realm. To this blunder has it been due that upon the shoulders of the inventor has been placed an onus of proof which he is to-day unable to bear. The subject is considered under the following headings:—(1) Is the legal standard of novelty a practicable one from an administrative point of view, or reasonable from the economic one? (2) To what extent can relief be granted from the legal requirement? (3) What modifications would it necessitate in the law and practice of letters patent? The opinion is expressed by "Historicus" that an official examination which would satisfy legal requirements is an administrative impossibility, and, further, that relief from the unduly high standard of novelty prevailing to-day is the primary need of the inventor. Such relief could, it is pointed out, be readily afforded him if the law and practice of letters patent were founded on the assumption that the applicant for protection intended "to make good" at the earliest op-

portunity. If this view found acceptance, the situation could be met by the institution of a preliminary examination limited in nature and extent, but sufficient in character to enable the inventor to approach the capitalist in the first instance with a broad claim for his invention, the title to which could be assured later by carrying out the manufacture of the invention within the realm.

THE controversy on the subject of mother-right which has arisen between Dr. E. Sidney Hartland and some American anthropologists is continued by Mr. R. H. Lowe in the University of California Publications on American Archæology and Ethnology (vol. xvi., No. 2). Dr. Hartland advanced two propositions: first, that normally, and apart from a few exceptions that seem well established, kinship was originally reckoned on one side only; secondly, that descent through the mother regularly preceded descent through the father. The objection raised to the first dogma is that almost uniformly the lowest tribes lack the unilateral mode of reckoning kinship. The second proposition is vigorously contested: the development of patrilinear out of matrilinear descent is denied as ignoring two vital groups of empirical phenomena—the frequent absence of the supposed symptoms among undoubtedly matrilinear peoples, and the enormous extent of borrowing. The matter is still *sub judice*, but the discussion, which is full of interest, may be commended to the notice of all students of sociology.

IN the University of California Publications in American Archæology and Ethnology (vol. xiv., No. 4) Mr. S. A. Barrett gives an elaborate account of a series of rites performed by the Wintun Indians, who formerly occupied a territory lying between the Sacramento River and the crest of the coast range of California. Their culture seems more closely related to that of the Pomo, adjacent on the west, than to that of the Maidu, who are separated from them by their own south-eastern kinsmen. The object of all their ceremonies, but especially that of the Toto and the Hesi, is, primarily, by a series of dances and dramatic performances, to ensure plentiful wild harvests, and, secondarily, to secure the health and general prosperity of the people. The performance of the Toto is believed to assure an abundance of green foods, such as Indian potatoes, by which is meant Brodiœa, Calochortus, and their bulbs, as well as the plants the foliage of which is eaten. The Hesi is thought to produce ripe foods in plenty: grass seeds, manzanita berries, and especially acorns.

IN *Mind* (N.S. 110, April) Mr. H. S. Shelton discusses the syllogism and other logical forms. His aim is to define more clearly than is usually done in text-books the exact sphere of logic, and to distinguish elements in it which, being of a metaphysical type, are misleading in logical argument. He maintains that in making any deduction three processes are involved:—(*a*) The abstracting from reality the concepts of the aspect with which we are dealing, (*b*) reasoning with regard to these concepts by means of some universal rule, and (*c*) the reference back again to reality of our conclusion. It is only when this last has been completed that we can be sure that our conclusion is materially true. He emphasises strongly that the sphere of deductive reasoning is not the sphere of empirical reality, and so logical conclusions require empirical verification. This view must not, however, be taken to imply that there is no sphere for formal logic; on the contrary, by defining more clearly what it cannot do, we are able to recognise what it can do. It is argued that the fundamental form of deductive reasoning is the syllogism, and that there is a sense in which all deductive reasoning, whether the rough and ready product of ordinary life or the more exact deductions of mathematical science, is and must be formal. In everyday life and ordinary arguments the various elements are so entangled as to obscure the essential characteristics of reasoning, and it is the function of logic to emphasise those aspects likely to be overlooked. The article should prove interesting both to men of science and to logicians.

AN artificial lava-flow, in places 6 ft. thick, was recently formed at a bottle factory in Kinghorn, Fife, by the corrosion of the floor of a tank through the solvent action of the glass. Seventy tons of "metal" were thus liberated, taking five days to cool, and developing, either directly or by contact-action with bricks, an interesting series of rock-forming minerals. The products have been carefully studied by Mr. G. V. Wilson from a petrographic point of view (Journ. Soc. Glass Technology, vol. ii., p. 177, 1918; see also NATURE, May 16, 1918, vol. ci., p. 217). Corundum occurs as a contact-product with bricks rich in alumina, and sillimanite, similarly developed, proves valuable as a protective lining on the bricks, as was pointed out in the discussion following the paper. Oligoclase arose in the absorption-zone between the bricks and the attacking glass, and small bipyramidal crystals of quartz, like those of many rhyolites, separated out in a portion of the glass that was stained violet by manganese and injected into the bricks after the main greenish glass. It is hence inferred that these later injections consolidated below 870°, and questions of temperature are critically considered throughout the paper. Tridymite and wollastonite were the only minerals developed in the general body of the glass, which is held, on account of the absence of pseudo-wollastonite, to have been at no time at a higher temperature than 1200°.

IN Professional Paper No. 17 of the Survey of India, Col. Sir S. G. Burrard makes an important contribution to the theory of isostatic compensation of inequalities in the earth's crust. Hayford in 1909 showed that in the United States this compensation is generally complete, and uniformly distributed in depth down to a uniform depth of about 110 km. But measurements of gravity in the outer Himalayas and in the adjacent alluvial plains of the Gangetic trough have hitherto been regarded as incompatible with the theory of isostasy. One suggestion which has been made to account for this is that in India the geological upheavals have taken place too recently to allow the compensation to be perfected as yet, but the anomalies in gravity seemed to correspond with over-compensation. Sir S. G. Burrard discusses this and other recent views on the subject preparatory to describing his own investigation, in which the novel point is that the excesses and deficiencies of density occurring in the different geological formations of the region are taken into account. In the past the theory of isostasy has been applied only topographically to the excesses and deficiencies of mass visible as mountains and oceans at the earth's surface; the density of the geological formation has not been considered hitherto because the depth to which any particular rock extends is frequently undetermined, so that its total volume and mass are unknown. Sir S. G. Burrard estimates the average depth and width of the Gangetic trough across six different sections, and adopts mean values of the density of the light rock deposits in the trough, including those into which, at no considerable depth, the alluvium is compacted by pressure. The crustal attenuation in the trough, assumed compensated for by denser rocks beneath, according to the isostatic theory, is shown to produce

negative anomalies of gravity over the trough, and positive anomalies on either side of it; these are, in fact, the discrepancies which required explanation. After showing the agreement of the theory with the Himalayan and Gangetic observations, Sir S. G. Burrard similarly discusses the data for other great Indian troughs, and finds further confirmation of the existence of isostasy.

THE Geophysical Journal of the Meteorological Office, or the British meteorological and magnetic year-book, for 1917, recently received, gives daily values of the several elements observed in the British Isles. Data are dealt with for solar radiation, meteorology, atmospheric electricity, terrestrial magnetism, and seismology. Results for the upper air are given for certain stations situated in different parts of the United Kingdom, and nephoscope observations are made at Aberdeen, together with tables showing the occurrences of aurora. The hours of bright sunshine are given for several stations and the percentage of the possible duration; the normal values for some stations are for thirty-five years. Meteorological results comprise pressure, temperature, wind direction and velocity, and precipitation; the values are taken from self-recording instruments. Estimation is made of the cloud amount and the weather. Magnetic data are given for the observatories at Kew and Eskdalemuir (Dumfriesshire). Earth temperatures and the mean level of underground water are given for each day at Kew Observatory. Referring to the anemographs and to the wind factor derived from the revolution of the cups of the anemometers, it is noted that "recent investigations have shown that the correct factor depends on the speed."

A NOTE from the Nela Research Laboratory which appears in the February issue of the Journal of the Franklin Institute deals with the observations of Mr. M. Luckiesh on the influence of temperature on the transmission of a number of commercial coloured glasses. In general, the transmission decreases as the temperature of the glass is raised from 30° C. to 350° C., and in some cases there is a slight change of colour of the light transmitted, which, from the table of results given by the author, appears to be towards the red end of the spectrum. For medium red glass coloured by copper the transmission at 350° C. is 84 per cent. of that at 30° C., for deep red copper glass 42 per cent., and for blue-green copper glass 82 per cent. For pink gold glass, purple manganese, and dull yellow glass it is 90 per cent. or more, while for lemon-yellow glass it is 71 per cent. The cobalt glasses transmit well, deep violet showing no diminution at 350° C., while light blue transmits at 350° C., 8 per cent. more than at 30° C. For a yellowish-green chromium glass the transmission is 67 per cent. only.

MR. HARRY J. POWELL's paper on glass-making before and during the war, recently read before the Royal Society of Arts, is a valuable summary of the achievements of the British glass trade in the very trying conditions of war. Many new types of manufacture were undertaken by individual firms, and especially in the field opened up by the war, which deprived this country of the different classes of scientific glassware obtained prior to 1914 from Germany. Thanks to assistance from Sir Herbert Jackson and the Institute of Chemistry (who supplied recipes of certain German glasses), this particular branch of the industry has obtained a good start in the direction of rendering our country independent of German supplies in future. The author, however, warned his listeners that Germany (and especially Jena) have probably made progress as well during the war. It therefore behoves British science and the glass industry to cooperate more clearly than in the past; and no doubt the new Institute of Glass Technology at Sheffield University will contribute in no small measure to the attainment of this object.

LICHTENBERG's dust figures caused by an electric spark were observed for the first time in 1777. Since then they have formed the subject of a long series of investigations. P. O. Pedersen has recently published in English the first part of a detailed examination of the subject (*Det Kgl. Danske Videnskabernes Selskab, Mathematisk-fysiske Meddelelser*, i., 11). In order to obtain pure and simple figures the Lichtenberg gap must be subjected to a very high impulsive voltage of very short duration. The size, shape, and character of the figures are independent of the nature of the plate and the mechanical and physical condition of its surface. They are controlled almost exclusively by the nature and pressure of the surrounding gas. The difference between the positive and negative figures is very striking. The pure negative figure appears as a white disc broken up into separate parts by a number of fine dark radial lines. It is attributed to ionisation by collision produced by electrons moving outwards from the electrode. The positive figures consist of sharply defined stems or trunks with short, well-defined branches or offshoots. It is suggested tentatively that they are due to positive particles moving outwards from the electrode. One difficulty in the way of this view is the fact that the velocity with which the positive figure spreads out from the electrode is two or three times greater than the corresponding velocity for the negative figure. The results already obtained seem to indicate that the elucidation of the formation of the figures will prove of considerable theoretical importance.

ALTHOUGH surveying by means of photography is a comparatively old art, and was actually employed more than twenty-five years ago for mapping some 25,000 square miles in America under conditions that rendered surveying by the usual method quite impossible, it is the recent war that has brought it into prominence, and done more than any other circumstance to demonstrate its advantages. Moreover, the recent methods are new so far as they allow the use of a very high viewpoint, and also the vertical position of the camera, which brings the sensitive plate parallel to the ground, instead of, as is usual, perpendicular to it. New conditions and new desiderata have led to the designing of new forms of cameras, and these we referred to a few weeks ago. But these new conditions have given rise to new problems, many of which were solved during the war, but for obvious reasons are only now getting published. In the *British Journal of Photography* for May 30 there appears a small series of articles on "Calculations in Aerial Photography," by M. L. P. Clerc, the results of which were empoyed by the French Aerial Photographic Service. In these M. Clerc considers "the lowering of the horizon line in photographs taken from high view-points," and gives a diagram which shows the extent of the lowering in mm. for various heights and various focal lengths of the objective. "The estimation of the height of objects by the measurement of their cast shadows in aerial photography" is also accompanied by a chart, in which a series of curves gives the height sought under the various conditions that affect the shadow. "The limit of admissible angling in vertical or horizontal photography" is, as in the other cases, worked out mathematically, and the results expressed in curves on charts for convenience in practice.

THE governing body of the College of Science, University of Calcutta, has expressed a desire that the researches undertaken in the various departments of the college should be published from time to time in the form of memoirs or bulletins. Through the courtesy of Sir Prafulla Chandra Rây, we have received a copy of the first of these memoirs issued by the department of chemistry; it is a volume devoted to the organic thio-compounds. Some of the papers have already appeared in a condensed form in the Journal of the Chemical Society; these have been incorporated with additional matter so as to present a connected account of the thio-compounds which give rise to tautomeric changes and to the formation of polysulphonium derivatives. The author remarks that time alone can show whether there will be a continuity in the regular issue of such memoirs, and warns those who intend to pursue chemistry in India that they must not expect to reap a rich harvest in the near future. For a thousand years or more India has been a *tabula rasa* so far as the cultivation of the physical sciences is concerned. "We in the East have been living in silent and ecstatic meditation." Pioneers in the introduction of Western science have no native tradition to follow up: they must formulate their own schemes and carry them out as best they may. At the same time, the work already turned out by some of the pupils is full of hopeful augury for the future.

MESSRS. DULAU AND CO., LTD. (34 Margaret Street, W.1), are offering for sale (in Catalogue No. 76) some nine hundred works in geology and palæontology, entomology, botany and agriculture, geography and travel. The list contains several scarce items, and long runs of scientific serials, but for the most part it deals with volumes of current interest and value, and the prices asked are most moderate. The catalogue should be seen by anyone wishing to form or add to a science library.

A NOTEWORTHY feature of the latest catalogue (No. 180) of Messrs. W. Heffer and Sons, Ltd., Cambridge, is the Oriental library of the late Dr. A. F. R. Hoernle, of Oxford, comprising more than four hundred items (the Sanskrit portion of the library is not included, being promised for a later catalogue). Other works offered for sale by Messrs. Heffer deal with folk-lore, mythology, and allied subjects; there is also a list of recent purchases in science books, many of which are publications issued abroad. The catalogue is sent free by the publishers upon application.

MR. J. Y. BUCHANAN, F.R.S., is publishing through the *Cambridge University Press* a volume entitled "Accounts Rendered of Work Done and Things Seen." It will comprise some thirty-three papers, mostly dealing with scientific subjects. Among them are several from our columns. Others are "Geography, in its Physical and Economical Relations"; "A Retrospect of Oceanography in the Twenty Years before 1895"; "On a Method of Determining the Specific Gravity of Soluble Salts by Displacement in their own Mother-liquor, and its Application in the Case of Alkaline Halides"; "On the Oxidation of Ferrous Salts"; "Lakes," and "On the Compressibility of Solids." The essays will be printed in their original form. *Messrs. H. K. Lewis and Co., Ltd.*, will shortly issue to subscribers "Sir William Osler's Anniversary Book," which is now in course of preparation by Sir W. Osler's pupils and colleagues numbering about a hundred.

OUR ASTRONOMICAL COLUMN.

NOVA AQUILÆ.—This temporary star, which appeared last year, is slowly pursuing its course of decreasing brightness, and is now about magnitude $6\frac{1}{2}$ or fainter. Observations by Mr. Harold Thomson, in the Journal of the British Astronomical Association for May, give 6·14 as the magnitude on March 28, 6·14 on April 26, 6·37 (the mean of observations with two instruments) on May 22, and 6·64 on May 26. These magnitudes are determined by comparison with the neighbouring star B.D. $+0°$ 4027, the magnitude of which is taken as 6·04. Mr. Thomson adds that the visual spectrum strongly resembles that of Nova Geminorum II. at a similar stage of its career. The continuous spectrum is still visible from about the position of the D line to near $H\gamma$. The brilliance of the nebula line at 5007 is intense. There is at least one bright line remaining of the group near D, which was so conspicuous in the early stages, and bright lines or bands are still visible near 464 and $H\gamma$.

THE PARALLAX OF THE ORION NEBULA.—The distance of this well-known nebula, or rather of the stars associated with it, has been determined both by Prof. Kapteyn and Prof. W. H. Pickering with considerable divergence in its amount. In both cases the results were deduced by a method which is practically comparing the brightness of the stars in question with the brightness of stars of the same types the distances of which are assumed to be known. Prof. Pickering obtained the value 0·0005″, whilst Prof. Kapteyn found 0·0054″. In the April issue of Publications Ast. Soc. Pac. Prof. Pickering attempts to explain this wide discordance by the fact that the same stars of the nebula formation were not used in the two investigations, and that the type of spectrum assigned, and therefore luminosity, were different. He now accepts 0·0020″ as the value of the parallax, and considers this to be a maximum value.

PLANETARY NEBULÆ.—The 60-in. reflector of the Mount Wilson Observatory is being used by Mr. van Maanen for the determination of stellar parallaxes photographically by the usual method relative to comparison stars. Mr. van Maanen is specially finding the parallaxes of nebulæ, and the distances of six of the planetary class have lately been published (communication to the National Academy of Science, No. 56, reprint). The absolute parallaxes of the central stars range from 0·008″ to 0·023″, and, the photographic magnitudes having been derived, it is possible to determine the absolute magnitudes, the mean of which for the six nebulæ is $+9·1$. This faint absolute magnitude is noteworthy because the spectra of these objects consist in many cases of bright lines, whereas with the stars in general bright-line spectra are usually associated with high luminosities, some Wolf-Rayet stars, for instance, the spectra of which resemble those of planetary nebulæ in some respects, having been found to have a mean absolute magnitude not far from 0. The linear dimensions of these objects can obviously be found from their measured angular diameters, and the major axis of the largest of the six, N.G.C. 6720, is given by Mr. van Maanen as 10,000 astronomical units, and the smallest, N.G.C. 7662, as 1350 units, which may be compared with the orbit of Neptune, the diameter of which is 60 astronomical units. It is to be noted that in the new General Catalogue these six objects are not described as planetary in every case, the two above-mentioned being in the annular class.

MEDICAL SCIENCE IN THE WAR.

SIR ANTHONY BOWLBY, at the annual general meeting of the Research Defence Society on June 26, gave an admirable little address on "Experimental Medicine and the Sick and Wounded in the War." He spoke with authority; there is no surgeon with more right to do that. But, of course, he could not do more than touch points here and there of the great subject. He took for these points typhoid, tetanus, gas-gangrene, dysentery, and trench-fever, and he began with this praise of our Army: that it had been the healthiest Army in the war, partly because "the average Briton is naturally a cleanly animal," partly because the British soldier understands a reasonable explanation, and is guided by it in daily life, and partly because our Army Medical Service, "a body of men unequalled in any other country on the face of the globe," was constantly lecturing to the combatant officers, who in their turn instructed their men in the ways of health. So it came to pass that the amount of "sick wastage" in our Army was kept low; and that is how the war was won.

If that were all, or anything like all, there would be some excuse for the foolish people who say that the health of our Army was safeguarded, not by experimental medicine, but by "ordinary sanitation." But, as Sir Anthony said, "the hygiene of to-day is based upon the experimental medicine of yesterday." It was hygiene to protect our men against typhoid and our wounded men against tetanus; but it came out of the experimental work of Nicolaier, Wright, and others; there was no possible way but that, if it was ever to come. He reminded his hearers of the vivid contrast early in the war between the British Expeditionary Force and the French Army; how France, to save herself, had to send out her Army unprotected against typhoid; there was no time to protect them; "the result was that between August 1 and April they had as many as 60,000 cases of enteric." He might have added the not less remarkable results of the protective treatment later in the war against paratyphoid.

Next, Sir Anthony spoke of tetanus. We all remember how, in the first months of the war, our national anxiety for our men was heightened by the dreadful news that there was a great deal of tetanus among the wounded:—"At the beginning of the war in France we had a truly terrible attack of tetanus among our wounded. Everybody was surprised and alarmed. The prevalence of the disease had not been anticipated, and consequently there was no prophylactic serum in proportion to the number of troops. We could not suddenly supply them with preventive doses of serum. It had to be made. We obtained all the supplies we could get from America, but it took time. In August, September, and October, 1914, our troops were to a great extent uninoculated, and the result was an appalling amount of tetanus. Shortly afterwards almost every man was able to be inoculated. The ratio of the number of cases of tetanus to the number of wounded was about six times as high in September, 1914, as it was in November, and nine times as high as it was in December of the same year."

Sir Anthony spoke also of experimental medicine in relation to the study and treatment of gas-gangrene and of dysentery, and he and Capt. Walter Elliot (who seconded a vote of thanks to him) spoke of trench-fever and of those memorable experiments on self, by British and American volunteers, which proved the transmission of trench-fever by lice, and made it possible to bring down "by leaps and bounds" the evil done by the disease. Strange to think, with these facts before us, that there are so many people who still belong to "anti-vivisection" societies.

EXPERIMENTAL STUDIES OF SELECTION.

MR. A. STURTEVANT has experimented (Publication 264, Carnegie Institution of Washington, 1918, pp. 1–68, 1 plate) with a mutant race of the fruit-fly, *Drosophila melanogaster* (*ampelophila*), with the particular object of determining the effects of selection. The mutant character in question is known as Dichæt; it appeared in 1915 in a single female which had wings extended and bent backwards near the base, and with only two dorso-central bristles instead of the usual four. This "Dichæt" character behaves as a dominant, and it appears that the factor or gene corresponding with it is located "in the third chromosome, approximately five units to the left of pink." Dichæt-flies are more variable in bristle-number than are non-Dichæts. The variability is partly environmental, partly genetic.

Selection is generally admitted to be capable of effecting change, either gradually or suddenly, in the mean character of a mixed race, but if this be granted a number of questions arise. *Does selection use germinal differences that are already present, or differences that arise during the experiment?* To this the author answers that selection produces its effects chiefly through isolation of factors already present, though occasionally available mutations do arise in the course of the experiment. *But if selection uses new differences, does it cause them to occur more frequently, and does it influence their direction?* To this the author answers that there are no available data warranting an affirmative answer.

What selection does is to isolate genetic differences already present. The experiments made on the Dichæt-fly go to show that genes are relatively stable, not being contaminated in heterozygotes, and mutating only very rarely. There is strong confirmation of the multiple-factor view that characters may be influenced by more than one pair of genes. There are genes that modify other genes, but there is no experimental evidence that allelomorphs present in the heterozygote may influence or "contaminate" each other, so that they do not come out unchanged. The general outcome of Mr. Sturtevant's elaborate investigation is to lead us to believe that the chief *rôle* of selection is in isolating favourable combinations of genes.

FUNGUS DISEASES OF ECONOMIC PLANTS.

OTTO A. REINKING (*Philippine Journal of Science*, vol. xiii., section A, July, 1918) supplies a list of fungus diseases of Philippine economic plants which will be of value to plant-growers in other tropical areas. The warmth and moisture of the climate account for the great number and destructiveness of these diseases during the wetter months of the year, and Mr. Reinking estimates that in the province in which he is specially interested at least 10 per cent. of agricultural crops are destroyed by fungi. The great factors in the spread and destructiveness of fungi are the lack of proper culture, of sanitation, of pruning, and of spraying. Many of the plants concerned are widely cultivated in the tropics, and the paper has been written in order to give some idea of the prevalence of plant diseases, their causes, mode of attack, plant hosts, the amount of damage, and also the methods of control. Many of the diseases are due to fungus species new to science. The account is illustrated by twenty-two plates and forty-three text-figures.

Under the title "Seedling Diseases of Conifers" (*Journal of Agricultural Research*, Washington, D.C.,

vol. xv., December, 1918), Carl Hartley, T. C. Merrill, and Arthur S. Rhoads have made a valuable contribution to the study of forest pathology. Damping-off is the most serious disease of very young seedling conifers, and several types of the disease are described. In addition to the well-known *Pythium debaryanum* and *Corticium vagum*, species of Fusarium and *Botrytis cinerea* have been isolated from affected seedlings, and are believed to be able to cause the disease. Artificial cultures of the fungus indicated a marked difference in virulence between different strains, which bears little or no relation to the host from which the strain was isolated. Thus strains from spruce and sugar-beet respectively proved more virulent in inoculations on pine seedlings than did any of the strains originally isolated from pine. Losses often wrongly attributed to poor seed are caused by the fungus killing the seed or the seedling before it appears above soil; and some of the damping-off fungi may continue to kill the roots of seedlings after they develop rigid stems, so that the plant does not fall over. The latter type of trouble is sometimes confused with damage caused by excessive heat or dryness of soil.

In the Memoirs of the Department of Agriculture in India (Botanical Series, vol. ix., November, 1918) W. McRae gives a detailed account of a new fungus disease (*Phytophthora meadii*) of a rubber plant, *Hevea brasiliensis*. This species of Hevea is now being extensively grown in the south-western region of the Indian peninsula. The most striking symptoms of the disease are the rotting of the fruit and the wilting and abnormal shedding of the leaves. Mr. McRae describes the external symptoms and the microscopic characters of the affected tissues, and also his experiments on inoculation; the structure and the life-history of the fungus are also fully described. The resting spores of the fungus are found in the fruits of the plant, and as the fruits are therefore the chief means of propagating the disease, the possibility is suggested of the destruction of the flowers in order to prevent the formation of fruit. This might be done by mechanically removing the flowers or by spraying them with a chemical that would kill them, but up to the present neither of these means has been found practicable.

THE FISHERIES AND THE INTERNATIONAL COUNCIL.[1]

I.

In former communications[2] it was shown how insignificant is the influence of man in affecting the plants, such as seaweeds and diatoms, abounding in the sea, and how little he can influence the lower marine animals, from microscopic elementary forms, through sponges, zoophytes, starfishes, annelids, shell-fishes, and cuttlefishes, up to fishes. It was further demonstrated in 1898 that the closure of the experimental areas (Forth, St. Andrews Bay, and Aberdeen Bay) had not affected the food-fishes, either as regards increase or diminution in numbers or size. Now it may be asked: Where have the melancholy anticipations of the pessimists been demonstrated; where has the serious diminution of any food-fish occurred; and where have the principles enunciated in "The Resources of the Sea" been traversed by the International Fisheries Council, the most extensive, and certainly the most expensive, combination of fisheries authorities the world has seen, which owed its existence to opinions (viz. those of the impoverishment theory) diametrically opposed to those of "The Resources of the Sea"?

In the lectures at the Royal Institution in 1907 the uncertainty of the Fishery Board for Scotland in connection with the further closures than those remitted to it was pointed out, for it had oscillated between an increase and a diminution of fishes in the experimental areas, and its own statistics in subsequent years proved the safety of the Scottish fisheries, which have been dealt with elsewhere up to 1912, when they were reviewed at the Dundee meeting of the British Association. No voice at that meeting was raised in support of the impoverishment of the sea, though Dr. Petersen, Dr. Mortensen, and Prof. Jungarsen from Copenhagen, and others specially interested were present. Indeed, Prof. Hubrecht, of Utrecht, also present, strongly supported "The Resources of the Sea," and stated that Prof. Huxley held the same views. Since 1912 similar prosperous records have been annually published by the Scottish Board up to 1913, the last year unaffected by the war, when the climax was reached, the value of the catch of fishes being no less than 3,997,717*l*. (or only 2283*l*. less than four millions), the highest value yet attained in the fisheries of Scotland, though the catch of herrings that year had been 758,756 cwt. below that of the previous one.

The same cause for satisfaction exists after a perusal of the captures, year by year, in such a bay as St. Andrews, where they have been under observation for at least half a century, and in which the pulse of the North Sea is felt day by day and month by month each season, with perhaps varying regularity, producing its fishes in greater or less abundance.

Before going into the results of the costly international scheme, it may be well to recall the remit made to the Council of that body. It was, in the first place, to benefit the British fisheries, to clear up the discrepancies between "The Resources of the Sea" and "The Impoverishment of the Sea"—in the words of Prof. Garstang: "It was the problem of all problems whether the conclusions in this book ['The Resources of the Sea'] were well or inadequately founded." The Council had also to ascertain "whether the quantity and consumption of fish taken from the North Sea and neighbourhood are in proper proportion to the production occurring under the prevailing natural conditions, and whether any disproportion between production and consumption arises from a local over-fishing or from an injudicious employment of the fishing apparatus at present in use." The flat-fish grounds were also to be investigated; annual results published; discoveries of practical importance to the fisheries made, such as "discovering the limit to which fishing grounds can be depleted without undergoing serious injury"; and, finally, recommendations for international action proposed. This formidable remit was, moreover, burdened by a heavy load of hydrographical, physical, chemical, and meteorological observations. Yet some members of the Council guaranteed results for international action within two years—a fact which demonstrates how little the situation was understood.

The earlier work of the International Council was dealt with on a former occasion, and since then the following gives a brief note of its labours:—

Reports on the quantitative distribution of the eggs and larvæ of the cod tribe and of the sardine and anchovy in the North Sea have been given by Hoek; on young salmon by Arwidsson; on the cod by Hoek; on the herring by Hjort and Lea; on the eel by Schneider; and on the mackerel by Nilsson, all containing additions to our knowledge, though they do not bear on the main question submitted to the International Council for solution. The Council was likewise

[1] From a lecture given in Aberdeen on March 4 by Prof. McIntosh, F.R.S.
[2] NATURE, vol. lxxvi., p. 301, 1907.

concerned about the capture of full-sized herrings by the ordinary trawl in daylight. A useful summary of the present knowledge of the mackerel fishery in Denmark, Sweden, Norway, Holland, Germany, Scotland, England, Ireland, France, Southern Europe, and the North-West Atlantic came from Ehrenbaum, the usual variations occurring throughout. This variability was further emphasised by Dr. Hugh Smith, of the United States, in the decline of the fishery there from 500,000 barrels in 1885 to 3000 in 1910; yet it had not been proved that the fishes had migrated to other grounds, such as western Europe, or had been decimated by the purse-seines.[3] Moreover, a similar experience had been met with in Norway.

As the oft-repeated statements concerning the diminution of the flat-fishes (Pleuronectids) had attracted public notice, the Council devoted a large amount of attention to this group. Thus Ehrenbaum, in two papers, took in hand the early stages from the eggs onwards, and their occurrence according to the months of the year; whilst Johansen discussed them in relation to the North Sea generally, a certain amount of duplication taking place. Ehrenbaum's first paper, perhaps, was the less important, for the subject had in many respects been dealt with previously. In his second paper he groups the pelagic eggs according to the presence or absence of an oil-globule, and appends two plates, the figures on which had, for the most part, been published by other authors. Hefford describes the proportional distribution of plaice in the North Sea, males slightly preponderating in small plaice, whereas in the larger forms females are in the majority, yet in the breeding season in the south (December to February) the catch of males by trawlers greatly exceeds that of females. Masterman's three reports on the late stages of the flat-fishes give much important information and noteworthy recommendations, but there is no indication of a serious diminution of any form. On the other hand, Johansen considers that the average weight of plaice in the Danish region of the North Sea has distinctly decreased since 1888—a different finding from a much longer experience in St. Andrews Bay. Heincke (1913) is of opinion that the Danish and German investigations show a deterioration of the stock of plaice, and that, apart from over-fishing, the destruction of small plaice is in itself sufficient to render protective measures desirable. He has not, however, proved that the small plaice are reduced in number—a vital point—and this though he states that 300,000,000 are annually destroyed, irrespective of the capture of plaice from two to thirty years old for sale, only 10 per cent. of which have produced eggs. He therefore proposes the sole legislative measures which the sixteen years' costly labours of the Council have produced, viz.: (1) Protection of the young plaice; (2) closed areas and seasons; and (3) a size-limit. The revival of the old size-limit is interesting, but its application is more than doubtful, especially when Heincke cannot prove definitely that plaice have diminished. Redeke concludes with an account of the local forms of plaice in Danish waters.

The Council has, indeed, expended a great amount of labour on the plaice, and it is no lack of sympathy with the various authors of the memoirs which prompts the statement that no trustworthy conclusion as to its serious diminution can be drawn from them, and they are in some respects duplicated. No author can definitely assert that the plaice is on the road to extinction. It is said that evidence to the effect that the diminution of the plaice "was already made clear to the House of Commons in 1893, and that all authorities are agreed that this fish shows serious diminution." But the statistics of the Fishery Board on which I and others relied in 1893 were found by a more stringent examination to be in need of modification, and in the history of the fisheries the plaice, as already mentioned, has of old been the subject of pessimistic views, just as those accounting for the absence of large plaice in inshore shallow waters—by over-fishing—rest on a misapprehension of the life-history of the species. The conjectures that only 10 per cent. of the captured adults have produced eggs, and that the removal of 20 to 40 per cent. from the North Sea annually is too great a loss to be compensated by natural means, are not the clear facts demanded by science and the State. Plaice have been taken from the North Sea from time immemorial, and yet are distributed to-day over its entire area, whilst their tiny young swarm on every suitable sandy or muddy beach. Though it is to be regretted that the destruction of the small plaice crowding on the sandy flats of the Continental shores still goes on, yet there is no marked diminution in their numbers. Heincke's suggestions for the protection of the young are of doubtful practical utility; besides, as Masterman says, why confine legislation to the plaice when the other flat-fishes are likewise supposed to be in need, and the round-fishes have an equal claim? Perhaps the pressure brought to bear on the Council to produce, after its lengthened labours, something tangible in the way of legislative recommendations may have had some connection with this step.

In "The Analysis and Review of the English Plaice-marking Experiments," published in 1916 by the Board of Agriculture and Fisheries, less ambitious views were promulgated, though it was thought that the transplantation of plaice on a commercial scale might yield a profit. Many important papers have been issued by the English Board, such as Masterman's report on the plaice fisheries of the North Sea, and the age, growth, and sexual maturity of this fish; Todd on the food of the plaice; Buchanan Wollaston on the spawning grounds of the plaice; Wallace on the age and growth-rate of the plaice, on the ear-bones, and on the size and age of the plaice at maturity; whilst others by Booley, Lee and Atkinson, Garstang, Bygrave, and Matthews show the scientific zeal of the Board's staff. The excellent work in marine zoology and in the fisheries which for more than thirty years has been carried on by the Marine Biological Association at Plymouth likewise speaks for itself.

The work of the northern section, as undertaken by the Fishery Board for Scotland, has also been reviewed up to 1907 in the second lecture at the Royal Institution. It was shown that, as a result of Hjort's discovery of vast swarms of young Gadoids from Jan Meyen southwards, there was little need for surprise at the immense hordes of young haddocks which, as last year, swarmed all along the east coast of Scotland, and as little need for doubting the resources of Nature in the sea.

Johs. Schmidt gives valuable information on the young stages of the cod tribe, of the lings, halibut, long rough dab, and the torsk, and, along with Petersen, describes the spawning ground of the eel in mid-Atlantic. H. M. Kyle produces two papers on the literature of the ten principal food-fishes of the North Sea and a catalogue of the fishes of northern Europe. Jensen (Norway) writes on the ear-bones of fishes from the bottom of the deep polar sea, and shows that cod may frequent the upper regions of the water and thus be overlooked. Johansen describes the history of the post-larval eel, and Petersen writes on the larval and post-larval stages of the ling, flat-fishes, eel, and on the fisheries of the Cattegat and Sweden. On the whole, the papers on the young stages of the

[3] This fishery has now largely improved.

food-fishes (with the exception of Schmidt and Petersen on the eel) do not show much that is novel, for most of these had long before been worked out from the egg to a recognisable stage in Scotland.

The third report of the northern section consists of a series of statistical tables of the round fishes from the Aberdeen trawl fishery, 1901–6, and a report of the fluctuations in the market price of fishes (Prof. D'Arcy Thompson). No conclusion is arrived at in regard to abundance or scarcity. The fourth report (1906–8) states that recent work has greatly added to our knowledge, "though without bringing us within reach of a clear statement and comprehension of the whole case," and this though results were guaranteed within two years. The report includes hydrographical investigations in the North Sea and Faröe-Shetland Channel, temperatures of the surface waters of the North Sea, salinity of the North Sea, and experiments with drift-bottles. The fifth report contains observations on the plaice caught by the *Goldseeker*, supplemented by statistics from the Aberdeen market, by the same author. It is stated that large plaice have diminished by two-thirds between 1905 and 1911, whilst the landings of extra small plaice (8 in.) have increased threefold. No explanation is given as to whether the ship worked on adult plaice grounds, or whether those in the fish market represented with any degree of trustworthiness the corresponding work of the earlier period; nor is it explained that the smaller forms are now saleable, whereas formerly they were not. In any case, the removal of the larger plaice by intensive fishing is the rule, but the gaps thus made are filled later by the swarms of the smaller. Besides, it is not stated that the search for the large plaice was in the same or similar areas and on the corresponding dates in each period. As already indicated, the wide distribution of the plaice over the North Sea is a safeguard. An able report by Dr. Fulton on the seasonal abundance of the flat-fishes in the North Sea follows. He concludes that turbot and brill are scarcer, halibut more numerous, large witches fewer, small witches less diminished, megrims less numerous, lemon-dabs (the decrease of which twenty years ago was a mainstay of impoverishment) have increased, plaice have decreased, yet off Kinnaird Head, a chief trawling area, small plaice have rather increased, though less so than small lemon-dabs and witches. An interesting and laborious report is given by the same author on the marking of plaice in connection with their migration, growth, and other features. The adult plaice seemed to travel further than the immature, and often against the current from the north, so that he was inclined to connect this with their reproduction, the eggs and larvæ being thus carried southwards; but such may be capable of other interpretations. At any rate, large plaice occur all along the eastern deep waters, and produce eggs and larvæ which pass shorewards there. Other papers are on egg-production of numerous fishes by Miss A. Mitchell, statistics of trawled fishes landed at Aberdeen, and a report on hydrographical investigations (1913). The fishery statistics of the world for 1911 and 1912 were given by Prof. D'Arcy Thompson in 1917, though the relation of this compilation to the task set before the International Council is not evident. The main fact is the prominence of Great Britain amongst the twelve countries selected. The preponderance of the total catch of fishes, moreover, in the North Sea is noteworthy, and bears out H. M. Kyle's view that there has been no diminution in the yield of the North Sea between 1907 and 1912. It would have been interesting to compare these with the fisheries of the United States and of the great British Colonies of Canada, Australia, and New Zealand. Other statistical papers, such as those on the Aberdeen trawl industry, by the same author, and by Helland-Hansen on the cod and haddock, need only be mentioned. They do not affect the general question.

The work of the trained scientific staff of the Fishery Board for Scotland, again, and independently of the International Council, has for many years been worthy of all praise. The researches of Dr. Fulton on the plaice and other flat-fishes, on the rate of growth and the food of fishes, their migrations, distribution, fecundity, ovarian eggs, and spawning, are both numerous and important. His reports on trawling, line fishing, herring fishing, and on the hatchery at Nigg still further add to our knowledge. The able work of Dr. H. C. Williamson is also equally creditable to the Board, and ranges over the various food-fishes, adult and young, edible crabs and shell-fishes, as well as includes interesting experiments on the effect of cold in connection with the transportation of fishes' eggs to distant regions, such as Australia. Dr. Thomas Scott ably took in hand the floating fauna, crustacean and annelidan parasites of fishes, the food of marine fishes, and the fauna of freshwater lochs. Mr. Harold Dannerig managed the hatchery at Dunbar, and for a few years that at Nigg, until he left for an important fishery post in New South Wales; but, unfortunately, this trained fisheries worker perished with the fishery research ship of the Commonwealth. Besides these, the talented George Brook, Prof. Milroy, of Belfast, Dr. H. M. Kyle, J. T. Cunningham, Dr. A. G. Anderson, Mr. E. W. Shann, and Dr. Bowman have all contributed to our knowledge of the fisheries.

In addition to the international work, the Danish Government carried out, by means of its vessel *Thor*, various independent observations. Thus Johansen (1907) marked numerous plaice, and found that growth was most rapid up to the third year, but on approaching maturity it was slower. He thought adult plaice sought the shallow water in spring and autumn (which has not been verified as yet in Britain), and that their rate of progress was from two to six miles a day. Johannes Schmidt, again, marked many cod in Icelandic waters, where they spawn chiefly off the south and south-west coasts in warmer water, for a polar current keeps the north and north-east shores cold through the year. In summer a branch of the warm current moves eastwards along the north coast, and he thinks it is important for young fish-life, since the young swarm in the fjords of the north and north-east, yet they pass the winter there, notwithstanding the temperature. He was of opinion that the mature plaice, which he also marked, migrated to reach warmer water for spawning, but he was uncertain of this in regard to the cod. He concluded by supposing that at the spawning period fishes generally require definite conditions of temperature and depth, whilst at other times they are indifferent to these. The same author describes the larval stages of various fishes, as also did C. J. Petersen. Semundsen (1913), from marking experiments, thought that both plaice and cod kept to Icelandic waters. Changes in the specific gravity of the floating eggs are noted by Jacobson and Johansen (1909); the latter also contributed several papers on the plaice, such as variations in the frequency of young plaice in Danish waters (1908). He could not say definitely that a low salinity of surface water caused a deficiency of young plaice in 1904, and is not sure but that a low temperature might be prejudicial to eggs and young. Papers of outstanding merit are contributed by Johs. Schmidt on the metamorphosis and distribution of the larvæ of the eel, on the occurrence of young eels (Leptocephali) in the Atlantic west of Europe, and on the distribution and classification of fresh-water eels

in the Atlantic; and this able author's experiences range to the marking of turtles in the West Indies. He also furnished an account of the European, American, and Japanese eels. Finding no racial differences in the common eel, he selected the viviparous blenny to illustrate this feature, those in the inner waters of a fjord having a reduced number of vertebræ, and the number of the rays in the breast-fin being increased from the mouth to the inner waters of the fjord. Kramp, again, reported on the eggs and larvæ of common fishes collected by the *Thor* in the Belt Sea. Wingo (1915) regards locality as a factor in determining the value of the rings on the scales of the cod, and is of opinion that there is no great distinction between summer and winter rings, whether the examples come from Danish or Icelandic seas. Struberg (1916), by marking experiments at the Faröes, found that the cod at the end of the first year were 16 cm. (about 6½ in.) long, at the end of the second year 30–35 cm. (about 12–14 in.), at the end of the third year 15 cm. (6 in.) longer, and the weight doubled and quadrupled; at the end of the fifth year an increment of only 5–6 cm. took place. The growth in all was distinctly retarded between October and January, but this varied according to locality. The cod remain in the neighbourhood, undergo no great migration, and reach maturity at the fourth year.

This work of the Danes is an example to the theoretical workers in other countries, since the zoologists were personally in touch with the sea and searched Nature for themselves; and it would appear that, by the skilful adjustment of the resources of a single nation, more satisfactory advances might be made than by any other means. Even international co-operation has its limits.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BRISTOL.—With the concurrence of the Society of Merchant Venturers, the council has appointed Major Andrew Robertson to the vacant chair of mechanical engineering. Prof. Robertson was demonstrator in engineering in the University of Manchester from 1908 to 1912; Vulcan research fellow, 1912–15; lieutenant in the R.N.V.R., 1915, and for some time has been head of the mechanical testing laboratory for the R.A.F. at Farnborough. The present occupant of the chair, Prof. J. Munro, has been granted the title of emeritus professor in mechanical engineering.

GLASGOW.—The following were among the degrees conferred on June 25:—*Doctor of Laws (LL.D.)*: The Very Rev. Principal Sir John Herkless, St. Andrews; Prof. Magnus Maclean, the Royal Technical College, Glasgow; and H. F. Stockdale, director of the Royal Technical College, Glasgow. *Doctor of Philosophy (D.Phil.)*: J. W. Scott—thesis, "Recent Philosophy and Recent Social Movements." *Doctor of Science (D.Sc.)*: W. M. Alexander—thesis, "A Research in Egyptology: The Ancient Egyptian Canals between the Mediterranean and the Red Sea, their Problems for the Sciences of Geology, Geography, Engineering, and History"; J. M. Campbell—thesis, "Laterite: Its Origin, Structure, and Minerals"; W. J. Goudie—thesis, "Steam Turbines (Text-book for Engineering Students)," with other papers; I. M. Heilbron—thesis, "A Contribution to the Study of Semi-carbazones: Their Reactions and Spectrographic Examination," with other papers; R. G. A. Holmes—thesis, "Design and Construction of H.M.S. *Argus*"; and H. G. Wigg—thesis, "The Balancing of Rotating Bodies."

LONDON.—Mr. Thomas Baillie Johnston has been appointed the first incumbent of the University chair of anatomy tenable at Guy's Hospital Medical School. Mr. Johnston received his medical training at the University of Edinburgh, graduating M.B., Ch.B., with First Class honours. In 1907 he was appointed demonstrator, and in 1911 lecturer, in anatomy at Edinburgh University. Since 1914 he has been lecturer on anatomy at University College, London, and has also acted as superintendent of dissections to the Conjoint Board.

Dr. Alfred Joseph Clark has been appointed, as from September 1, 1919, to the University chair of pharmacology tenable at University College. Dr. Clark was educated at King's College, Cambridge, and at St. Bartholomew's Hospital; was demonstrator in pharmacology at King's College, 1911–12; assistant in pharmacology at University College, 1912–13; and lecturer in pharmacology at Guy's Hospital, 1913–14. Since December, 1918, he has been professor of pharmacology in the University of Cape Town.

The following doctorates have been conferred by the Senate:—*D.Sc. (Engineering)*: Mr. O. S. Sinnatt, an internal student of King's College, for a thesis entitled "Thermo-dynamics of Metal Bars." *D.Sc. in Physics*: Mr. F. L. Hopwood, an external student, for a thesis on acoustics.

The thanks of the Senate have been accorded to Mrs. Row for her donation of 1000*l*. for the department of zoology at King's College in memory of her son, Harold Row, who was lecturer in zoology at the College from 1911–19. The income from this donation is to be devoted to the purposes of a scholarship for the promotion of zoological research, to be called "The Harold Row Scholarship."

The syllabuses for the Intermediate Science Examination for external students were approved as alternative syllabuses for the Higher School Examination, and resolutions were passed regarding the award of the higher school certificates.

MR. W. ELLIOTT has been appointed principal of the Technical Institute, Rathmines, Dublin, in succession to the late Mr. A. Williamson.

THE U.S. General Education Board has, says *Science*, made a grant of 100,000*l*. towards a fund of 400,000*l*. to be raised to endow a graduate school of education for Harvard University. The new fund will be named in honour of Dr. Charles W. Eliot, president emeritus of Harvard University.

MR. J. B. ROBERTSON, assistant in the chemistry department, University of Edinburgh, has been appointed lecturer in chemistry in the South African School of Mines, Johannesburg. Mr. A. E. Walden, also an assistant in the same department, has been appointed professor of chemistry in the Wilson College, Bombay.

Two scholarships of the value of 150*l*. per annum each, and tenable for three years, will be offered by the Institution of Naval Architects this summer, viz. the Cammell Laird scholarship in naval architecture and the Parsons scholarship in marine engineering. Candidates must be British apprentices in shipyard or marine-engine works, between the ages of nineteen and twenty-five. Entries close on August 11. Full particulars can be obtained from the Secretary, Institution of Naval Architects, 5 Adelphi Terrace, London, W.C.2.

THE Gilchrist Trustees offer, through the council of the London (Royal Free Hospital) School of Medicine for Women, a special scholarship tenable at the Medical School by a woman who has served under an organisation directly connected with the war during not less than three years since August, 1914. The

scholarship is of the value of 50*l.* per annum for five years. Applications must reach the Warden and Secretary of the Medical School, 8 Hunter Street, Brunswick Square, W.C.1, not later than July 12.

WE learn from *Science* that the Washington School of Medicine, St. Louis, has been offered the sum of 30,000*l.* by the General Education Board on condition that an equal amount be raised by subscription. This fund of 60,000*l.* is to be used for the endowment of the department of pharmacology. From the same source we learn that the board of trustees of the University of Tennessee have voted 20,000*l.* to the medical school to be used for a new laboratory building to be erected in the rear of the Memphis City Hospital. The new building will have laboratories for pathology, bacteriology, chemistry, and physiology.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 19.—Sir J. J. Thomson, president, in the chair.—The Hon. R. J. **Strutt**: Bakerian lecture: A study of the line-spectrum of sodium as excited by fluorescence. An improved form of sodium vapour lamp, in quartz, was described, giving an intensely bright sodium spectrum, admirably adapted for exciting sodium vapour to resonance. It is found that excitation of sodium vapour by the second line of the principal series leads to the emission of both λ 3303 and the D line. On the other hand, as might be expected, excitation by the D line leads to the emission of the D line only, without 3303. If only one of the components of the doublet 3303 is stimulated, both the D lines are emitted. When D light falls on sodium vapour of appropriate density, it is known that an intense surface emission occurs from the front layer, and a weaker one from succeeding layers. Analysis by absorption in an independent layer of sodium vapour shows that the superficial emission is more absorbable, and therefore nearer the centre of the D lines. The breadth of the D lines in superficial resonance has been estimated by interferometer methods. It is found to correspond with the breadth conditioned by the Doppler effect, calculated on the assumption that the luminous centre is the sodium atom. Polarisation could not be detected in the ultra-violet resonance radiation, though, in accordance with previous observers, it was readily observed in D resonance.

Mineralogical Society, June 17.—Dr. A. E. H. Tutton, past-president, in the chair. A. E. **Kitson**: Diamonds from the Gold Coast. The crystals and their occurrence were described.—A. **Brammall**: Andalusite (chiastolite): its genesis, morphology, and inclusions. In a survey of thermometamorphic "spotted" rocks, evidence based on structural features, optical properties, and microchemical reactions is adduced to show that certain types of spots, convergent towards such minerals as chiastolite, andalusite, cordierite, mica, and chloritoid, record arrested development, and that they are probably ontogenetically related. The spot is a complex system containing a volatile phase, water, and its development involves metamorphic diffusion and differentiation, controlled by changing conditions of temperature and stress, the tendency being towards the attainment of an equilibrium end-point in a metastable mineral. Thermal and stress conditions adequate to initiate the tendency may be inadequate to sustain it, the time factor also being involved; development may be arrested and abortive effort recorded as a mineral "spot," the nature of which is determinable, but is often vague or wholly conjectural. The chemical and physical characters of argillaceous sediments are considered, with special reference to the genesis of chiastolite. Clays contain a high proportion of hydrated silicates of alumina, readily soluble and in part probably colloidal. On rise of temperature diffusion effects the segregation of the primary clot; diffusion inwards of allied molecules and diffusion outwards of alien substances tend to promote homogeneity and reconstitution within the spot, the peripheral zone being maintained for a time in a relatively high state of hydration. In this connection the peripheral zone of yellow-brown, non-pleochroic, and isotropic stain is significant; microchemical tests show that it is due to ferric hydrates, which are known to be liable to spontaneous dehydration, and it is suggested that the ferric hydrate in the peripheral stain acts as a catalyst, assisting dehydration within the spot and transmitting water to the base. For chiastolite (andalusite), a mechanism of formation is suggested to cover the observed facts, to explain the characteristic distribution of its opaque inclusions, and to account for crystals which have the superficial aspect of cruciform twins.—R. H. **Rastall**: The mineral composition of oolitic ironstones. In many oolitic ironstones the ooliths contain more iron or are more highly oxidised than the matrix. Assuming that the iron-content of such rocks is introduced by metasomatism of calcium carbonate, this may be explained in the following way: Many ooliths and organic fragments in limestones consist of aragonite, while the cement is calcite. Aragonite is less stable than calcite and more readily decomposed by iron-bearing solutions, which therefore attack the aragonite first, while the calcite is replaced later. Hence we have the following scheme in successive stages:—

Ooliths. aragonite ⟶ chalybite ⟶ limonite.
Matrix. calcite —— calcite ⟶ chalybite.

The ooliths are always a stage ahead of the matrix in replacement and oxidation. The origin of the green silicate of iron, found in many ironstones, requires further investigation.—L. J. **Spencer**: Eighth list of mineral names.

Royal Anthropological Institute, June 17.—Prof. A. Keith, past president, in the chair.—J. Reid **Moir**: Flint implements from Glacial gravel north of Ipswich. This gravel is covered by a definite Glacial boulder clay, and is therefore of Glacial age. Mr. W. Whitaker states that the gravel is what is usually called "Middle Glacial," and this view is shared by the author. As, however, Lower Glacial deposits do not occur in the Ipswich district, the use of the term Middle Glacial is deprecated. The flint implements comprise small platessiform specimens, very similar in their outlines to some of the Early Chellian artefacts, points, *radoirs*, and well-made scrapers. These and the numerous flakes recovered exhibit all the usual characteristics of flints ascribed to human workmanship. Quartzite hammer-stones and burnt flints occur in the gravel, and the deposit probably represents, in part, a land surface broken up and re-deposited by water resulting from melting ice. It is not at present possible to correlate the Ipswich gravel with others in different parts of the country containing similar implements, but further investigation may enable this to be done.

Zoological Society, June 17.—Prof. E. W. MacBride, vice-president, in the chair.—J. T. **Carter**: Occurrence of denticles on the snout of Xiphias.—Dr. C. W. **Andrews**: New species of Zeuglodons and a leathery turtle from the Eocene of Southern Nigeria.—E. **Heron-Allen** and A. **Earland**: Experiments on the cultivation of *Verneuilina polystropha* Reuss, in hypertonic sea-water and gem sand.—C. **Morley**: Equatorial

and other species and genera of African Ichneumonidæ.—G. A. **Boulenger**: (1) A list of the snakes of West Africa from Mauritania to the French Congo. (2) A list of the snakes of North Africa.—The Rev. T. R. R. **Stebbing**: Crustacea from the Falkland Islands collected by Mr. Rupert Vallentin. Part iii.

Linnean Society, June 19.—Dr. A. Smith Woodward, president, in the chair.—T. A. **Dymes**: Notes on the life-history of the yellow flag (*Iris pseudacorus*, Linn.), with special reference to the seeds and seedlings during their first year. *I. pseudacorus*, Linn., is a plant of shallow swamps and wet pastures, occurring in many different kinds of soil. Its xerophytic adaptations and its contractile roots are a protection from some of the dangers of the physical world. Its acridity and astringency protect it from being readily eaten, but the larvæ of some insects feed upon it, those of a sawfly doing considerable damage; a few molluscs resort to it for food. It appears that wild-fowl eat the seeds and the very young seedlings; it is also attacked by a parasitic fungus. This plant hibernates, and the normal minimum for the seeds is about seven months, the maximum being not less than twenty. Flowering in its fourth year, the capsules begin to dehisce in September. There are two kinds of seed, flat and round, and the difference between them has some significance both in dispersal and in germination. Uninjured seeds float for two years or more. The most important of the agents are diving wild-fowl, and the least is the wind; running water plays a very considerable part.—S. L. **Moore**: A contribution to the flora of Australia. This memoir contains notices of rare and descriptions of new Australian plants preserved in the British Museum.—A. W. **Waters**: Selenariadæ and other Bryozoa. The paper deals with some cup-shaped or flat forms of Bryozoa, and while the zoarial shape alone is sufficient for generic classification, an examination has been made to see how far other characters run through all or most species.—Dr. E. **Penard**: Studies on some Flagellata. The author gives the result of his observations on some Flagellata from the vicinity of Geneva.—Dr. W. M. **Tattersall**: Report on the Stomatopoda and Macrurous Decapoda collected by Mr. Cyril Crossland in the Sudanese Red Sea.

BOOKS RECEIVED.

Life and its Maintenance: A Symposium on Biological Problems of the Day. Pp. viii+297. (London: Blackie and Son, Ltd.) 5*s*. net.

George Westinghouse: His Life and Achievements. By F. E. Leupp. Pp. xi+304. (London: J. Murray.) 15*s*. net.

Resources and Industries of the United States. By Prof. E. F. Fisher. Pp. ix+246. (Boston and London: Ginn and Co.) 3*s*. 9*d*. net.

Heredity. By Prof. J. Arthur Thomson. Third edition. Pp. xvi+627. (London: J. Murray.) 15*s*. net.

Woman: The Inspirer. By E. Schuré. Translated by F. Rothwell. Pp. vii+166. (London: The Power-Book Co.) 4*s*. 6*d*. net.

A Practical Handbook of British Birds. Part iii. Pp. 129–208+2 plates. (London: Witherby and Co.) 4*s*. net.

The Chemistry and Manufacture of Hydrogen. By Major P. L. Teed. Pp. vii+152. (London: E. Arnold.) 10*s*. 6*d*. net.

On Longevity and Means for the Prolongation of Life. By Sir H. Weber. Edited by Dr. F. Parkes Weber. Fifth enlarged edition. Revised and partly rewritten. Pp. xxii+292. (London: Macmillan and Co., Ltd.) 12*s*. net.

The Metals of the Rare Earths. By Dr. J. F. Spencer. Pp. x+279. (London: Longmans, Green, and Co.) 12*s*. 6*d*. net.

La Tension de Vapeur des Mélanges de Liquides. L'Azéotropisme. By Dr. M. Lecat. Pp. xii+319. (Gand: Hoste, S.A.; Bruxelles: H. Lamertin.) 45 francs.

Practical Vaccine Treatment for the General Practitioner. By Dr. R. W. Allen. Pp. xii+308. (London: H. K. Lewis and Co., Ltd.) 7*s*. 6*d*. net.

Descriptive Geometry. By H. W. Miller. Pp. v+176. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. net.

Introductory Mathematical Analysis. By Dr. W. P. Webber and Prof. L. C. Plant. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 9*s*. 6*d*. net.

Irrigation Engineering. By Dr. A. P. Davis and H. M. Wilson. Seventh edition. Pp. xxiii+640. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s*. net.

Annals of the Philosophical Club of the Royal Society written from its Minute Books. By Prof. T. G. Bonney. Pp. x+286. (London: Macmillan and Co., Ltd.) 15*s*. net.

Practical Butter-making. By C. W. Walker-Tisdale and T. R. Robinson. Fourth revision. Pp. 143. (London: Headley Bros. Publishers, Ltd.) 5*s*. 6*d*. net.

The Doctrine of Degrees in Knowledge, Truth, and Reality. By Viscount Haldane. Pp. 32. (London: H. Milford.) 2*s*. net.

The Book of Cheese. By C. Thom and Prof. W. W. Fisk. Pp. xvi+392. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8*s*. net.

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THURSDAY, JULY 10, 1919.

PRODUCTIVE DUALITY.

(1) *Strife of Systems and Productive Duality: An Essay in Philosophy.* By Prof. W. H. Sheldon. Pp. x+534. (Cambridge, Mass.: Harvard University Press; London: Humphrey Milford, Oxford University Press, 1918.) Price 15*s*. net.

(2) *Self and Neighbour: An Ethical Study.* By Edward W. Hirst. Pp. xx+291. (London: Macmillan and Co., Ltd., 1919.) Price 10*s*. net.

THE idea, deeply ingrained in our intellectual nature, that the constituents of reality, could we only discriminate them, would be found to be single and simple is neither borne out nor supported by any actual research, scientific or philosophical. We are for ever asking what a thing is, and for ever surprised that the only answer we can get is in terms of what a thing does. Doing implies process, process means activity, and the concept of activity involves the idea of opposition within the concept itself.

(1) Prof. Sheldon, in his interesting survey of the strife of systems, has made a bold application of this fact to the problem of philosophy. He presents difficult problems in a pleasant, flowing style which is itself a source of pleasure to the reader. The thesis which he defends is that the lack of unity in philosophy and the tendency of philosophical systems to present sharp antagonisms, far from being, as is so often urged by critics, a scandal of reason, are the very conditions of progress. It is no new doctrine; it is, in fact, the well-known Hegelian theory of the dialectic, according to which the advance of thought is through contradiction and pure negation to new affirmation and a higher synthesis. Prof. Sheldon proposes, however, a bold application of the principle which would bring within it the Hegelian philosophy itself as one of the systems in strife. This antagonism does not merely concern human systems of thought. "The deepest trait of reality, that which makes it the moving, productive thing it is, is just the marriage of two principles whose apparent hostility has constituted the continual frustration of man's effort to map the universe."

(2) Mr. Hirst deals with this strife of systems in the ethical sphere. It is not difficult to understand why at the present time there is a lively interest in the ethical problem. Human society is undergoing a reconstruction so fundamental that the chance seems now offered to reformers to make actual and practical ideals which a few years ago seemed remote and visionary and possible of realisation only by steady and persistent perseverance in the course of generations. The millennium, it is true, loses its æsthetic charm as a vision when it becomes plain matter of fact; none the less, the widespread feeling at the present time that, whatever the outcome of our social reconstruction, we are at least enjoying an opportunity such as few now living could have expected to see is setting its stamp on our speculative thought.

Practical reformers are not usually tolerant of the speculative theorists, and the reason is not far to seek. If the science of political economy has earned for itself the epithet "dismal," the science of ethics most certainly deserves the epithet "dull." Nowhere in the whole scheme of philosophy and science does there seem to be such laborious effort combined with such discouraging flatness as in the sphere of speculative ethics, and yet theoretically ethics is the culminating interest in philosophy. Mr. Hirst's "Ethical Study" cannot escape this condemnation, although it makes a brave attempt. It lacks vision and has no audacity. It discusses the problem along the well-worn lines of the attempt to reconcile egoism and altruism. It contains a good deal of critical exposition of modern theories, particularly those of the late T. H. Green and the present Bishop of Down, and it is very sympathetic towards Dr. Rashdall's "Theory of Good and Evil." It is in the exposition of these writers that the ethical interest of the book centres. The criticism of the earlier classical writers is inadequate, and the quotations are so often at one or even two removes that an uncomfortable doubt creeps in as to the author's acquaintance with the original. And when we are told that "we owe to Plato one of the greatest literary works, in which he sketched the constitution of an ideal society," we wonder what class of readers the author has in mind! The one contemporary philosopher who really may be said to have raised the problem of ethics to a higher plane, Benedetto Croce, is not mentioned, and possibly the "Philosophy of Practice" is as yet unknown to the author. Croce's distinction between economic and ethical conduct in that treatise appears to the present writer to have placed the ethical problem in a new setting and altered the conditions on which it will in future be discussed.

Mr. Hirst's book is not confined to ethics; we are soon switched on to pure psychology, and then from psychology to pure metaphysics. The author is thoroughly at home in the most recent philosophical literature in England, and his work is extremely well-informed and instructive. Though he freely expresses his agreement or disagreement with the various theories he notices, we never get a clear expression of his own view developed independently. It is this we should like to have, and the disappointment with which we close the book in not having got it is perhaps the highest praise the author can wish for as regards the interest his book arouses.

H. W. C.

TEXT-BOOKS OF CHEMICAL ANALYSIS.

(1) *A Systematic Course of Qualitative Chemical Analysis of Inorganic and Organic Substances, with Explanatory Notes.* By Prof. Henry W. Schimpf. Third edition, revised. Pp. ix+187. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 7*s.* net.

(2) *Essentials of Volumetric Analysis: An Introduction to the Subject, Adapted to the Needs of Students of Pharmaceutical Chemistry.* By Prof. Henry W. Schimpf. Third edition, re-written and enlarged. Pp. xiv+366. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 7*s.* net.

(3) *An Advanced Course in Quantitative Analysis, with Explanatory Notes.* By Prof. Henry Fay. Pp. vi+111. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 6*s.* net.

(1) THIS volume is intended especially for pharmaceutical students, and the author has borne in mind the fact that such students can devote but a relatively short time to the study of analytical chemistry. Hence the endeavour has been made to confine the work to those qualitative chemical reactions, both organic and inorganic, which it is considered essential for students of pharmacy to master. An ample course has been provided; but the book is frankly didactic rather than educative.

In carrying out the scheme, much use is made of "charts" and tables of procedure, not only for the analysis of mixtures, but also for examining simple salts. A useful feature is the plentiful employment of equations in explanation of the reactions: this is a matter on which the average student is often weak. Although the "organic" part of the work has been written in reference to the United States Pharmacopœia, it will be found quite serviceable by students in this country. The matter is both well arranged and well printed.

In a work of this character there seems to be no sufficient reason for including a section dealing with elementary chemistry (atoms, valency, symbols, salts, etc.). The sixteen pages devoted to it cannot take the place of an ordinary chemical text-book; and that being so, they might be more profitably devoted to analytical matters. It may be noted that, in the chart on p. 72, *sodium* metantimonate, instead of the potassium salt, is, by an oversight, shown as the reagent to be used in testing for sodium.

(2) Like the foregoing work, this volume is also designed for the use of pharmaceutical students. Hence, in addition to descriptions of the general principles of volumetric analysis, chapters are included which initiate the user into methods of dealing with medicinal substances. Such methods are, for instance, those used in the estimation of alkaloids volumetrically, and in the assaying of vegetable drugs and galenical preparations. With these may be mentioned the processes used for the determination of phenols, nitrites, sugars, and alcohol; assays of drugs, such as chloral and resorcinol, and the examination of oils, fats, and waxes. The chapters in question will be found to be excellent introductions to these parts of the subject.

The earlier chapters give good explanations of the general principles and practice of volumetric analysis. They are provided with numerous worked-out examples to explain the calculations involved.

Whilst, however, the book, on the whole, will be found convenient and useful, it would be improved here and there by a revision of the wording. Such sentences as "the sensitiveness of the indicators and its colour changes is ascribed to . . ." (p. 21) do not well express the author's meaning. The revision of proofs, too, might have been better done. Thus the statement that "oleomargarin requires about one mil of beef-fat" (p. 285) will be found rather cryptic by the student, until he realises that somehow or other "decinormal alkali" has been transformed into "beef-fat" during its passage through the press.

(3) Work of a rather advanced kind, suitable for students who have already gone through a good introductory course, is provided in this third volume. The subjects chosen are such as to afford experience in the methods used for assaying minerals and metals. The analysis of silicates is first dealt with, and this is followed by that of spathic iron ore, pyrites, and titanium iron ore. After a few more exercises, including the proximate analysis of coal, the student is taken on to the analysis of phosphor-bronze and the determination of the numerous substances present in various kinds of iron and steel. These examples will indicate the nature of the experimental work to be carried out. Except as regards coal, the estimations are concerned with inorganic substances only.

A notable feature of the book is Prof. Fay's explanatory notes, which will be found very helpful, as will also the original references provided. The methods of analysis used are such as would be employed in actual working practice, and the book can be cordially recommended to the notice of advanced students and their tutors.

THE VALUE OF A GARDEN.

A Garden Flora: Trees and Flowers Grown in the Gardens at Nymans. By L. Messel. 1890–1915. With illustrations by Alfred Parsons. Foreword by William Robinson. Notes by Muriel Messel. Pp. ix+196. (London: *Country Life* Offices and George Newnes, Ltd.; New York: Charles Scribner's Sons, 1918.) Price 10*s.* 6*d.* net.

THE garden at Nymans, Sussex, is without doubt a particularly favoured spot. It rises to some 500 ft. above sea-level, and has a good loam soil overlying sandstone. As might be ex-

pected from such a soil, the garden contains a wealth of rhododendrons and heaths and other interesting plants which only flourish where chalk is absent from the soil.

The remarkable list of the plants grown in the garden which the late Miss Messel has drawn up, to the memory of her father, Mr. L. Messel, the founder of the garden, is not only a splendid tribute to one who took the keenest interest in the cultivation of all that was rare and interesting, but also a most valuable work for all true garden-lovers.

The book enumerates all the plants grown at Nymans, a sufficiently remarkable collection to warrant its publication, and its value is much enhanced by the notes added by Miss Messel about the plants of more especial interest. Particulars as to the hardiness of numerous tender plants grown in the garden are also given, and all those that are half-hardy or doubtfully hardy, as well as those grown under glass, are specially marked.

The volume, which is beautifully printed on excellent paper, is enriched by the drawings of Mr. Alfred Parsons of plants which have flowered in the garden. So good are these that one would have welcomed some more from his accomplished pencil.

One reads through the lists of plants with envy, especially when the sizes of some of the more tender plants are noted. To find *Embothrium coccineum, Berberidopsis corallina, Abutilon vitifolium*, and four species of Acacia, among other tender plants, flowering out of doors so near London is remarkable.

One reason of Mr. Messel's success, with plants which are not usually considered hardy, was that he grew such plants with some protection during the winter, until they were large enough and strong enough to plant in the open. Had they been put out as small plants the failures would have been numerous.

In the appendix a list of the plants killed or severely damaged during the winter of 1916–17 is given. On the whole, the casualties are remarkably small, and it is particularly interesting to notice the somewhat unexpected survivors of the severe winter.

It is with great regret that we have to record the death of Miss Messel in December last from influenza.

OUR BOOKSHELF.

Electro-Analysis. By Prof. Edgar F. Smith. Sixth edition, revised and enlarged. Pp. xiv + 344. (Philadelphia: P. Blakiston's Son and Co., 1918.) Price 2.50 dollars net.

At one time electro-analysis did not find much favour among chemists, because an analysis required too long a time, too complicated apparatus, and too much platinum. These objections have to a great extent been removed, largely through research by Prof. Edgar F. Smith, whose rapid precipitation of metals by the method of the rotating anode, introduced in 1901, has overcome the difficulty of time. Also of particular importance is his double mercury cup, the usefulness of which has been greatly enhanced by recent improvements described in the present edition of this book. The principle of this double cup is the same as that of the Castner-Kellner caustic soda plant. Remarkable success has attended the application of this method, not only to the complete analysis of single salts, such as sodium chloride, but also to the effecting of certain difficult separations, such as that of the alkali metals from one another.

Apart from a short chapter on "Theoretical Considerations," this book is entirely devoted to practical details, which are very fully given. Nevertheless, the author speaks with the confidence of one who has acquired his knowledge by actual experience, and has researched for more than forty years untrammelled by any electrochemical theory, whether of ions or of potentials.

The rareness among analysts of familiarity with electricity still remains a serious obstacle to progress in electro-analysis, and will remain so as long as electricity receives the little attention at present given to it by the chemist-in-training. If we have in view both speed and accuracy the best procedure in analysis is neither purely chemical nor purely electrical, but comprises a judicious blending of the two methods, and for guidance in electro-analysis every chemist should have a copy of the present standard work.

Francis W. Gray.

The Journal of a Disappointed Man. By W. N. P. Barbellion. With an introduction by H. G. Wells. Pp. x + 312. (London: Chatto and Windus, 1919.) Price 6*s.* net.

There have before now been clever young men who by their own efforts have conquered circumstance and won distinction in science, but, thank goodness, none of them has ventured to publish his high opinion of his own merits and his contempt for his neighbours, if not for the rest of mankind. Had he kept his own counsel, like the rest of us, Barbellion would doubtless have passed for a bright boy-naturalist, a student of zoology deserving all encouragement, and an amiable colleague when by hard work he won a post at the Natural History Museum. One would have recognised his brains, originality, and power of presentation, and one might have regretted to see another promising morphologist pinned for life to systematic entomology. His restless energy might have moulded to his own fashion that cramping environment, or might have raised him above it, had it not been for the slow and fatal disease against which he was struggling from the first. For that tragedy, for his courage and humour, and for his unquenched love of Nature, which here finds beautiful though rare expression, we can forgive his self-love, self-pity, and self-exposure, and place his journal on our shelf next that of Marie Bashkirtseff.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Military Camouflage.

ARTICLES on military camouflage have frequently appeared in both scientific and popular journals, but the picture drawn is invariably very different from the reality as seen by those who made the camouflage. The following remarks attempt to correct some of these inaccuracies by setting out as clearly as possible the conditions under which the military camoufleur worked.

Military information is obtained by horizontal observation from first-line trenches, by horizontal and oblique observation from kite-balloons, and by vertical observation from aeroplanes. Horizontal observation has a limited field of a few miles, whereas vertical observation is limited only by the distance an aeroplane can cover and return. The latter is thus of much the greater importance, especially because with the aid of photography very much greater detail can be obtained than by direct observation.

Even in forward areas open to horizontal observation camouflage requires to be proof against aerial photography. What escapes the long-focus camera carrying rapid and fine-grained plates will be passed by the eye even aided by optical instruments.

An example will illustrate most of the governing factors. Suppose that it has been decided to conceal a machine-gun emplacement by an artificial haystack. Either it must take the place of an existing stack or recently cut grass must account for its sudden appearance in the photograph. The comparison of photographs taken at different dates was a routine practice. The artificial stack must be of the size and form of haystacks of the neighbourhood; any defect in these respects would be recognised photographically by measurement of its cast shadow or by exaggerated stereoscopic examination. Any two photographs taken from about the same height suffice for stereoscopic examination.

If the stack be made of artificial material, such as canvas, and matched in colour to the eye, it may be discovered by the use of colour-filters or plates sensitive to special regions of the spectrum. The Germans used a very rapid plate the sensitiveness of which was almost confined to the green region. To ensure that the colour composition of the artificial was not at fault, it is best to use hay or straw in its construction. This is best for another reason in order to copy so far as possible the texture of the natural, for under the changing angles of illumination in Nature it is not possible to match constantly a rough surface by a smooth artificial, and this difference is likely to be seen sooner or later by the reader of aerial photographs. It is clear, therefore, that to defeat the aerial camera an exact copy is required. Amongst animals such concealment is comparable with that of Kallima, the leaf-butterfly. What may be termed impressionistic methods commonly found in animal coloration are quite useless for the defeat of the reader of aerial photographs. For concealment against horizontal observation the same methods had to be employed, as the object is constantly being scrutinised by many eyes, aided by binoculars, colour-filters, etc., exercising systematic observation, as well as being subject to vertical observation. An observation post in a sandbag parapet had to be concealed by a wire-gauze screen modelled to resemble exactly the sandbag removed for the purpose.

Many military objects were successfully concealed by erecting flat covers over them. These were made of fish- or wire-netting threaded with strips of canvas painted green or brown, according as to whether the surroundings were grass or earth. The paints used were made to give as nearly as possible the same colour-composition as grass, earth, etc. The required texture was obtained by leaving the ends of the canvas strips long. The cast shadow was concealed by gradually thinning out the canvas strips towards the edge, so that no defined shadow was cast. Under such covers, and more especially on rough ground, guns and other military objects were successfully concealed. This is, again, a case of exact copying except for the cast shadow, which is concealed by thinning out the edge in a manner similar to the standing coats and serrated edges of some animals.

The difficulty of concealing guns was greatly increased because they could be located with considerable accuracy by flash-spotting and sound-ranging, though to pin-prick them on the map detection by aerial photography was required. Still, these other methods of detection narrowed down the area to be examined often to the size of a halfpenny.

Further, the reader of aerial photographs became very skilled in detecting the presence of concealed objects from signs, tracks, moved earth, unusual agricultural activities, activities along roads and rails, and in many other places distant from the object, so that a camouflaged object was likely to be subject to the minutest examination and the smallest defect unlikely to be overlooked.

Meticulous care in the smallest detail was, therefore, essential, especially because a detected camouflage gave a false security. The degree in which accuracy was necessary may be conveyed by the following example. An attempt was made to represent a light-railway track by dark lines painted upon canvas, the canvas representing ballast. The painted rail was not so dark in the photograph as the real rail. It was found essential to make a raised rail of rope and canvas in order to cast the same shadow as a steel rail.

Unfortunately, especially during the early stages of the war, commanding officers often did their own camouflaging. This work almost invariably consisted of imitative painting, generally of an exceedingly childish kind, or, on the other hand, they succeeded in making the object more conspicuous by the use of conventional patterns in gaudy colour. In fact, painting for land camouflage was of no value except possibly to lower the reflection at night from, say, a hospital roof by the use of dark green or black paint when no texture was available. It is from the work carried out without technical advice from the Camouflage Corps that the public has been led astray, and it is to counteract this incorrect impression that the foregoing description may be of value.

ADRIAN KLEIN.
J. C. MOTTRAM.

Question Relating to Prime Numbers.

THE reply to Mr. Mallock's inquiry in NATURE of June 19 is that if n denotes the m^{th} prime number (counting from unity), then the ratio of m to $n/\log_e n$ tends to unity as m tends to infinity. It follows that an approximate expression for n is $m \log_e m$.

These results (known as the prime number theorem) were conjectured by Legendre, and were first proved about a quarter of a century ago by Hadamard and by de la Vallée Poussin. References to the somewhat

extensive literature on the subject will be found in Landau's "Handbuch der Primzahlen."

It would be of interest if Mr. Mallock would construct the graph for the function $m \log_e m$ which corresponds with the graph given on p. 305.

G. N. WATSON.

The University, Birmingham.

LORD RAYLEIGH, O.M., F.R.S.

THOUGH any adequate account of Lord Rayleigh's contributions to science will require time and extend far beyond the limits of a short article, the loss of one who has so long been their leader cannot be passed over by physicists without some immediate attempt at an appreciation and acknowledgment of the discoveries he made and the services he rendered to science.

For more than fifty years Lord Rayleigh put forth without any interruption and without a trace of diminution in quality or quantity a succession of researches covering almost every branch of the older physics. As the five volumes of the "Collected Papers," which only include those down to 1910, contain 349 papers, he must during his career have published nearly 400 papers; not one of these is commonplace, and there is not one which does not raise the level of our knowledge of its subject. Collected papers are apt to form a kind of memorial tablet in our libraries to men of science, but, if I may judge from my own experience, Rayleigh's are a remarkable exception; there are few, if any, books which I consult more frequently than these volumes and from which I derive greater delight and benefit. No small part of this is due to the clearness and finish with which they are written.

Rayleigh had, like Kirchhoff, the spirit and feeling of the artist in the preparation and presentation of his papers. His mathematical analysis seemed to flow naturally into the most concise and elegant form, and, whatever might be the difficulty of the subject, it was never increased by any obscurity or ambiguity as to the meaning of the writer. This quality was so ingrained that it could resist the rush and excitement of a competition as keen as that of the Mathematical Tripos; for when he was Senior Wrangler in the Tripos for 1865 one of the examiners said: "Strutt's papers were so good that they could have been sent straight to press without revision."

Another feature brought out by this collection of papers is their catholicity. The papers are indexed under the headings Mathematics, General Mechanics, Elastic Solids, Capillarity, Hydrodynamics, Sound, Thermodynamics, Kinetic Theory of Gases, Properties of Gases, Electricity and Magnetism, Optics, Miscellaneous; and there is such a goodly array under each of these headings that it is difficult to decide in which branch of physics his work was the most important. Rayleigh once said to me that he sometimes speculated whether he would not have done better to concentrate on a more limited field. Probably, however, in these matters one's mind takes the bit between its teeth and chooses the path in which it can work to the best advantage.

Whatever may be the subject of the paper, some characteristics are always apparent. One of these is the quite exceptional power Rayleigh possessed of seeing what was the essence of the question; he always went straight for the critical spot. Another—perhaps to a considerable extent the result of the last—was the remarkable gain in clearness any subject acquired after it had passed through his mind, which was like a filter which cleared every subject passing through it from obscurity and error. He seemed to delight in encountering and clearing away difficulties, and had a high opinion of the value of difficulties in helping one to get a better grip of the subject. Once, in speaking to me about one of the extraordinarily few cases in which later investigators had arrived at results appreciably different from his, he laid great emphasis on this point, and said that the investigation in question was one of the very few in which from beginning to end he had not been conscious of any difficulty. Another characteristic was the soundness of his judgment. I question if in this respect he has ever been surpassed; his mind was crystalline, not affected by any cloud of prejudice; he did not dislike or shy at an idea because it was new, neither did he think that because it was new it was necessarily better than the old.

To pass to the discoveries and results contained in these papers, there are such a multitude of high peaks that it seems almost invidious to single out any for special mention. In optics we have the series of papers on the scattering of light by small particles, and the proof that the molecules of air are sufficiently large and numerous to account for the colour of the sky. The study of this subject Rayleigh resumed from time to time, and it has of late been taken up from the experimental side with great success by his son. Other noteworthy papers on optics are his researches on the resolving power of optical instruments and on the nature of white light. His article on light in the "Encyclopædia Britannica" is remarkable for clearness of exposition and novelty of outlook. The paper on the resultant amplitude of vibrations of the same period and arbitrary phase, though written primarily for its optical application, has proved of great importance in connection with the scattering of rapidly moving particles and with the phenomena of viscosity and diffusion.

In hydrodynamics we owe to Rayleigh the theory of the formation and stability of jets; researches in capillarity of fundamental importance; the theory of the stability of motion in viscous fluids; the theory of the resistance experienced by a plane when moving through a liquid, with its application to the theory of flight, a subject in which he took great interest, and in which he was a pioneer. His book on the "Theory of Sound" may be said to have found the subject bricks and left it marble; it is ideal

from the point of view of a text-book and also as a record of original research. In general dynamics we owe to him great extensions in the application of the principle of reciprocity, and researches on the general theory of vibrations of dynamical systems and on the partition of energy. All these researches present a perfect amalgamation of physical principles and mathematical analysis; the physics guides and directs the analysis, while the analysis gives definiteness and point to the physics.

On the more purely experimental side we recall Rayleigh's classical determination, made mostly in co-operation with Mrs. Sidgwick when he was Cavendish professor, of the absolute measure of the fundamental units of electricity. Among the experimental researches is the one by which he is most widely known and in which he perhaps opened up the newest ground—the discovery of argon. As an inadequate estimate of the part Rayleigh took in this discovery is not uncommon, it may be as well to recall the facts relating to it. In a letter to NATURE in 1892 he said he had been much puzzled by the difference between the density of the nitrogen obtained from the air and that obtained from compounds of nitrogen. The latter was always considerably lighter. He followed this up by a paper, published in 1894, in which he showed that there was no variation in the density of nitrogen prepared from different nitrogen compounds, so that this must be regarded as true nitrogen, and that the heaviness of the nitrogen obtained from the air must be due to the presence of a heavier gas; it was shown in this paper that this gas could not be any of the gases known to chemists. This view was not universally accepted by chemists, convincing as the evidence was, for it seemed to some of them incredible that the atmosphere contained large quantities of a gas which had quite escaped dilution.

In his search for this gas Rayleigh was fortunate enough to secure the co-operation of Sir William Ramsay, and their joint work was so successful that at the meeting of the British Association in Oxford in 1896 they were able to announce the discovery that the air contained about ½ per cent. of a new gas, argon. This gas proved to have remarkable properties and to belong to a new family in the chemical elements, many other members of which were afterwards discovered by Sir William Ramsay. Though both shared in running down the hare, it was Rayleigh alone who started it, and this not by a happy accident, or by the application of new and more powerful methods than those at the disposal of his predecessors, but by that of the oldest of chemical methods—the use of the balance.

A remarkable feature of Rayleigh's experimental work was the simplicity of the apparatus with which the results were obtained; it has been said of him that he needed nothing for his experiments but some glass tubing and a few pieces of sealing wax. The many Continental and American physicists who visited Terling were filled with amazement that such important results could have been obtained with such simple apparatus. His example shows that, provided you can "mix your colours with brains," there are still regions in physics in which good work can be done with modest appliances; at the same time, it is true that there are other regions in which time would be wasted unless powerful and elaborate appliances were available.

Though Rayleigh's activities were mainly engaged with research, he did very important work in other fields. He held from 1879 to 1884 the Cavendish Professorship of Experimental Physics at Cambridge—there seemed something peculiarly appropriate in his holding a professorship with this title, for the work of Cavendish and Rayleigh had many characteristics in common. While at Cambridge he not only made the determinations of electrical constants already alluded to, but in conjunction with Glazebrook and Shaw he also organised the teaching of theoretical and practical physics, and made for the first time the laboratory take an integral part in the training of students of science. The writer, who was a pupil of his at Cambridge, remembers well the assistance he gave to those working in the laboratory, and how greatly a talk with him cleared up one's notion of a subject and helped to overcome difficulties.

Rayleigh was for eighteen years professor of natural philosophy at the Royal Institution, and was scientific adviser to the Elder Brethren of Trinity House. He had been secretary and afterwards president of the Royal Society, and since 1908 Chancellor of the University of Cambridge. He took the keenest interest in the formation and development of the National Physical Laboratory; he was chairman of the executive committee from the beginning until a few months before his death, and his interest, advice, and influence have played a very large part in securing the success of that institution. He was a member of the Advisory Council for Scientific and Industrial Research, and as chairman of the Committee for Aeronautics rendered great service to the progress of aviation. Throughout the war his advice was of much assistance to many committees engaged in the applications of science to naval and military purposes.

Though Rayleigh disliked even more than most men the loss of time inseparable from attendance at committees and meetings, he took his full share of such work, and it has been a great thing for British science to be able to call to its councils a man whose judgment was never influenced by prejudice or by a shadow of self-seeking.

J. J. T.

JOHN WILLIAM STRUTT, third Baron Rayleigh, was born in Essex on November 12, 1842, and succeeded his father in the title in 1873. He was educated at Trinity College, Cambridge, taking his degree as Senior Wrangler in 1865. His immediate neighbours in the Tripos' list were Prof. Alfred Marshall and Mr. H. M.

Taylor. The same year he obtained the first Smith's prize, and in 1866 became a fellow of his college. He married Evelyn, daughter of Mr. James Maitland Balfour, of Whittingehame, and sister of Mr. A. J. Balfour, the Foreign Secretary. Of his four sons two survive him—Robert, now professor of physics in the Imperial College of Technology, who succeeds to the title; and Arthur, who for a great part of the war was navigating officer on the flagship of the 1st Battle Squadron. They, with their mother, were present at their father's funeral, which took place at Terling on Friday last.

For some years after his marriage Lord Rayleigh lived at Terling. During this period he wrote a number of papers, which at once secured for him a position as a leader in physical science.

The Cavendish professorship of physics was established in 1871, and Maxwell became the first professor. On Maxwell's death in 1879 Lord Rayleigh was invited to return to Cambridge as professor and carry on the work of equipping the Cavendish laboratory, which had been built and fitted by the generosity of the seventh Duke of Devonshire, then Chancellor, and of establishing a school of physics in the University. He had served as examiner in the Mathematical Tripos of 1876, and had been in touch with the developments then proceeding in Cambridge. He retained the professorship until 1884, when he resigned, and was succeeded by Sir J. J. Thomson. The same year he visited Montreal as president of the British Association on the occasion of its first meeting outside the British Isles. From 1887 to 1905 he was professor of natural philosophy in the Royal Institution, and from 1887 to 1896 secretary of the Royal Society. He held the office of president from 1905 to 1908, and in the latter year succeeded the late (eighth) Duke of Devonshire as Chancellor of the University of Cambridge, an office he retained until his death.

In 1896 he became scientific adviser to the Trinity House. About the same time, as the result, in great measure, of discussions at the British Association meetings at Ipswich (1895) and Liverpool (1896), a scheme for a National Physical Laboratory took form, and Lord Rayleigh became chairman of a Treasury Committee appointed by the late Lord Salisbury to consider and report on the question. The Committee reported in 1898 in favour of establishing the laboratory as a "public institution for standardising and verifying instruments, for testing materials, and for the determination of physical constants." Lord Rayleigh was appointed by the Royal Society as chairman of the executive committee to which the management of the laboratory was entrusted, and retained the office until a few weeks ago, when failing health compelled him to resign.

In 1908 an important International Conference on Electrical Units was held in London, and Lord Rayleigh presided over its deliberations, which have since had very important results.

About the same time the importance of research in aeronautics began to be realised, and he was consulted by Mr. Haldane, then Secretary of State for War, as to the best method of enlisting the help of men of science in promoting flight. The appointment of the Advisory Committee for Aeronautics was the result; Lord Rayleigh became its first president in 1909, and continued to hold the office until very shortly before his death.

His advice was sought by successive Governments on very various scientific matters. He was for some time a member of the Explosives Committee; he also held the appointment of gas referee for the metropolis. The Department of Scientific and Industrial Research was established in 1917, and Lord Rayleigh became one of the first members of the Advisory Council appointed to advise the Minister in charge of the Department on scientific and technical questions. His work was recognised by his contemporaries both at home and abroad. He was one of the first members of the Order of Merit and a Privy Councillor.

In 1904 he was awarded the Nobel prize. From the Royal Society he received the Copley, the Royal, and the Rumford medals; he was an honorary fellow of Trinity College, Cambridge, a doctor of science of many universities, an Officer of the Legion of Honour, foreign member of the Institute of France, and an honorary or corresponding member of numerous other learned societies both at home and abroad.

Such is the very brief record of the life of a great Englishman, by whose death, at the ripe age of seventy-six, the world has lost immensely. His earlier papers were published at the beginning of the seventies of last century; the *Philosophical Magazine* for May, 1919, contains what is probably his last paper—"On the Resultant of a Number of Unit Vibrations over a Range not Limited to an Integral Number of Periods."

For some fifty years Lord Rayleigh worked and added to the sum of human knowledge, and though he had passed the allotted span of life and was approaching the age of four-score years, yet was his strength then not labour and sorrow, for he retained to the full the power of clear thinking, the firm grasp of first principles, and the ability to appreciate almost at first sight the essentials of any problem that appealed to him which had made him great. "The works of the Lord are great, sought out of all them that have pleasure therein," is the motto he prefixed to his five volumes of collected papers. Few men have done more to seek out and make clear the laws of Nature; few have taken more pleasure in their task or helped more wisely to smooth the path of those who follow in the search.

This is not the opportunity to give any detailed account of that work; perhaps it is scarcely necessary. Lord Rayleigh's papers up to 1910 have been collected by the Cambridge University Press and issued under his own editorship in five volumes. It is to be hoped another volume may be added to complete the work up to the present day. This is all

the more desirable as it will afford an opportunity of putting on record his work as president of the Advisory Committee for Aeronautics. Many of the investigations of the Committee have rested on the principle of similarity, which in its application to the problems of flight was first clearly explained by him in one of the earlier volumes of its reports.

For the rest, reference may be made to two reviews of the volumes of "Scientific Papers" which appeared in these columns for July 30, 1903, and October 23, 1913; in these and in the article published in the series of "Scientific Worthies" in NATURE of August 18, 1904, some account of Lord Rayleigh's work is given. A quotation from the first-named article may perhaps be made here. After referring to a paper dealing with the measurement of electrical resistance, the article continues: "The paper exhibits in a marked degree Lord Rayleigh's great capacity for seeing distinctly the essential points of an experiment or a measurement, and keeping that clearly in view throughout. This, indeed, is the distinguishing feature of his experimental work, a main factor in his success. Those who knew the Cavendish Laboratory when the electrical measurements were going on or have since visited the laboratory at Terling, from which no less important work is continually being published, have sometimes been surprised at the makeshift character of much of the apparatus. Contrivances of wood and wire and wax do duty where most men would use apparatus elaborated with a quite unnecessary care; but in Lord Rayleigh's case, while the essential instrument on which the accuracy of the result really depends is as perfect as the skill of the workman can make it, and, in addition, has been thought out in all its details, so as to fit it best for the purpose immediately in view, for the rest the arrangement which comes first to hand is utilised without regard to appearances."

The last of the great Cambridge mathematicians of the past century, Cayley, Adams and Stokes, Maxwell and Kelvin, Lord Rayleigh was one of the famous men praised by the writer of the book of Ecclesiasticus: "Leaders of the people by their counsels, and by their knowledge of learning meet for the people, wise and eloquent in their instructions. . . . Their bodies are buried in peace; but their name liveth for evermore." R. T. G.

IT is now nearly sixty years since the Hon. J. W. Strutt, eldest son of the second Baron Rayleigh, entered Trinity College, Cambridge, to study for the Mathematical Tripos. The Lucasian Professor of Mathematics, G. G. Stokes, was at the time engaged in working out the laws of fluorescence and in writing his report on "Double Refraction" for the British Association; Prof. W. Thomson, of Glasgow, had published his great paper on "The Dynamical Theory of Heat"; Prof. J. C. Maxwell, of King's College, London, was writing those fundamental papers on "Electrodynamics" which were incorporated in his "Electricity and Magnetism"; and Balfour Stewart, of the Kew Observatory, had laid the foundations for the modern laws of radiation. The new undergraduate became Senior Wrangler and first Smith's Prizeman in 1865, and next year was elected to a fellowship. His first scientific paper, published in 1869, illustrated electrodynamic laws by comparison with those of mechanical models, a method much used by Maxwell in his own papers. Next year his paper on "Resonance" appeared, and this was the forerunner of a long series of experimental and theoretical papers on vibrations in general, which, when embodied in his "Theory of Sound," made that work unique.

In 1871 the Cavendish Professorship of Experimental Physics was founded at Cambridge, and, urged by Strutt, Maxwell became the first holder of the chair. In 1873 Strutt succeeded his father as Baron Rayleigh, and on the death of Maxwell in 1879 became Cavendish professor. During the intervening years his scientific work had been chiefly in optics and hydrodynamics, and he had published important papers on waves and on diffraction gratings, while at the Cavendish Laboratory his experimental work consisted mainly in a continuation of the determinations of electrical standards inaugurated by Maxwell as a member of the Electrical Standards Committee of the British Association. Working, in the first instance, with Dr. Schuster, and afterwards with Mrs. Sidgwick, he showed that the B.A. ohm was 1 per cent. too small, and established values for the electrochemical equivalent of silver and for the electromotive force of the standard Clark cell, which have been confirmed by more recent measurements. Under the instigation of Lord Rayleigh, other determinations of fundamental importance were made in the laboratory, such as J. J. Thomson's work on the number of electrostatic units in the electromagnetic unit, and Glazebrook's on the B.A. ohm.

In addition to his work on electrical standards, Lord Rayleigh continued his acoustical observations, and took up the subject of surface tension and its influence on the behaviour of jets. He resigned the Cavendish professorship in 1884, having during his five years' tenure of the office contributed fifty papers to the advance of science. During the next three years his researches were mainly on optics and on electricity In 1887 he became a secretary of the Royal Society and professor of natural philosophy at the Royal Institution, holding the former office until 1896, and the latter until 1905. His lectures at the Royal Institution invariably showed how thoroughly he was master of any subject he presented, and how skilled he was in devising new and simple experiments to illustrate his statements. His work during these years was in the first instance mainly on light, and included his "Wave Theory of Light" contributed to the "Encyclopædia Britannica" in 1888.

A little later Lord Rayleigh took up the dynamical theory of gases and the question of the stability of the flow of fluids, then the densities

of gases, and was led by this work to the discovery of argon. Later still he wrote on the constitution of the natural radiation from a heated body, on the sensitiveness of the ear, and on electric oscillations, in addition to taking up again a great number of questions on which he had previously written, in order to complete the solution of some problem hitherto only partially solved, or to fill up gaps in our knowledge.

It is impossible to look through the five volumes of Lord Rayleigh's collected papers, which have already been issued, without being struck with the vastness of the field over which his labours extended, his thorough acquaintance with the work of others, and the facility with which he could bring together the loose threads of a series of investigations and weave them into the consistent fabric recognisable as part of Nature's handiwork by "all them that have pleasure therein." The tale of his scientific work cannot be completed from his published papers. His services on scientific committees have been innumerable and invaluable, and there are very few of the younger men who came in contact with him who do not owe him a debt of gratitude for help and encouragement in the face of difficulties which seemed at the time insuperable. C. H. L.

PROF. ADRIAN J. BROWN, F.R.S.

THE sudden tragic close of the life of Prof. Adrian Brown on July 2, following the decease, only three days previously, of his wife, is a grievous shock to his many friends, and a great loss to chemistry, on the biological side in particular, as well as to the brewing industry. We can ill afford to lose men of his quality; always rare, present-day conditions do not favour their production.

A younger brother of Dr. Horace Brown, his early life was passed in Burton-on-Trent. He received his first lessons in chemistry from his brother, and was technically trained under Frankland at the Royal College of Science, which he entered soon after the school was established at South Kensington by the removal there, from Oxford Street, of the Royal College of Chemistry together with most of the staff of the Royal School of Mines from Jermyn Street.

On leaving college he became private assistant to Dr. Russell at St. Bartholomew's Hospital. In 1874 he was appointed chemist to Messrs. Salt and Co., brewers, of Burton-on-Trent. In 1899 he accepted the charge of a new department of the University of Birmingham devoted to the fermentation industries—the first of its kind. He filled this chair with conspicuous success, and was still in office at the time of his death in his sixty-seventh year.

In the 'seventies Burton-on-Trent was a remarkable centre of scientific activity, and full of inspiration for a young worker. Peter Griess was steadily laying the foundations of the azo-colour dyestuff industry, though nominally a brewing chemist (at Allsopp's); Cornelius O'Sullivan, who had accompanied Hofmann to Berlin, had returned to England to act as chemical adviser to Bass and Co., and was engaged on his pioneer investigation of the hydrolytic cleavage products of starch; and Horace Brown, at the brewery of Worthington and Co., was giving substance to the ideas communicated in Pasteur's "Etudes sur la Bière." These three men were leaders in an eminently alert society.

Plunged into such an atmosphere, and influenced by heredity, Adrian Brown could not but develop, but he did so gradually and on individual lines; the scientific copyist was not then in vogue. Turning his attention, naturally enough, to the problems of fermentation, he specially studied the oxidising organisms and the influence of oxygen on fermentation. His first paper, dealing with the action of *Bacterium aceti*, was published in 1886; in a later communication he described the results obtained with another organism, *B. xylinum*. In both cases he was able to show that the organism influenced oxidation in a selective manner. In this work, which was entirely original, he was far in advance of his time, and its importance was not recognised—indeed, is not yet recognised, notwithstanding Bertrand's later work on the subject.

Adrian Brown was the first to suggest that in cases of hydrolysis by enzymes the catalyst enters into combination with the hydrolyte.

In 1907 he began the publication of a series of remarkable observations made with a blue barley, showing that in the outer skin of the grain there is a differential septum impermeable by strong acids and alkalis and by most salts but penetrable by weak acids, ammonia and a large number of neutral substances, such as the monohydric alcohols, chloroform, etc. This work led to his election to the Royal Society in 1911.

Although a man of retiring habits and full of modesty, his personal charm of manner endeared him to all his friends. He exercised a wide influence on account of his experience and judgment, being much respected in his industrial circle. As a teacher he was remarkably successful, owing to his sympathetic attitude, his unlimited patience, and his faculty of realising the difficulties of his students. H. E. A.

THE TRANS-ATLANTIC FLIGHT OF THE R 34.

A DIRECT trans-Atlantic passage has been accomplished by the rigid airship R 34, which left East Fortune at 1.42 a.m. on July 2 and arrived at Long Island, New York, at 2 p.m. G.M.T. on July 6. The total distance flown was approximately 3100 nautical miles, giving an average speed of 33 land miles per hour. This low figure is accounted for by the adverse winds which were encountered, and also by the fact that the commander, Major Scott, was sacrificing speed for safety. Some difficulty was experienced at first on account of the low altitude necessitated by the

great weight of fuel carried. Atmospheric disturbances were great at the mouth of the Clyde, near high hills. The weather was cloudy during the whole crossing, and only occasional glimpses of the sea were obtained to estimate the drift of the airship. Near Newfoundland the weather was very bad, and two electric storms were encountered, during which the wind varied rapidly from 10 to 50 miles an hour, and the airship was so tossed about that the crew gave her up for lost. It was after this trying period that Major Scott wirelessed for help, saying that his petrol was running short. Two destroyers were at once sent to render assistance, but Major Scott decided to attempt the completion of the journey under the airship's own power. His decision proved a wise one, and the great airship safely reached her mooring-ground in Long Island, but with only sufficient petrol remaining for a further ninety minutes' flight. The voyage was a very trying one for all concerned, and none of the crew had more than a few hours' sleep during the crossing.

The commander and crew are to be heartily congratulated on their great feat, and we can but admire the splendid pluck with which they carried on in the face of such great difficulties. It is obvious that in fair weather the R 34 would make the crossing with perfect ease, but it is also clear that we have a long way to go before the commercial use of trans-Atlantic airships is a reasonable proposition. The time taken when adverse winds are met is not very much less than that occupied by the fastest liners, while the useful weight which can be at present carried is extremely small. It is likely that larger airships will overcome the latter difficulty, since the gross lift of an airship varies as the cube of its length, while the power required for a given speed varies as the square. It follows that the larger ship has the greater percentage of its total lift available for useful merchandise. The great endurance of the airship is well brought out by the present flight, for it is almost certain that no existing aeroplane could have made the crossing under the same conditions. It is scarcely fair to attempt to form general conclusions as to the future of the airship from a pioneer flight made in circumstances of exceptional difficulty, and it would be wiser to wait until the feat has been repeated several times, when the possibilities of a commercial service and the directions in which improvement is to be sought should become apparent.

NOTES.

IN reply to a question in the House of Commons on July 8, Mr. Cecil Harmsworth stated that the appointment of Major C. E. Mendenhall, professor of physics in the University of Wisconsin, as Scientific Attaché to the United States Embassy has been notified to the Foreign Office by the United States Ambassador. No steps have as yet been taken by his Majesty's Government to appoint a Scientific Attaché to Washington. We believe the appointment of Prof. Mendenhall was a war measure, and that it has yet to be decided whether the post will be made permanent now that peace has been restored. It would be a progressive act on the part of our own Government to appoint Scientific Attachés to our chief Embassies.

MR. J. W. SIMPSON, corresponding member of the Institute of France, has been elected president of the Royal Institute of British Architects in succession to Mr. H. T. Hare.

THE Animals (Anæsthetics) Bill, which would make it an offence to perform certain operations on horses, dogs, cats, and bovines without the use of anæsthetics, was read a second time in the House of Lords on July 7, and was referred to a Select Committee.

MR. E. S. GOODRICH, Aldrichian demonstrator of comparative anatomy in the University of Oxford, has been elected membre-correspondant of the Société de Biologie of Paris, and also associé of the Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique.

Two John Foulerton studentships for original research of medicine, the improvement of the treatment of disease, and the relief of human suffering will shortly be awarded by the Royal Society. The studentships are each of the annual value of 400*l.* and tenable for three years, with the possible extension to not more than six years. They are open to men or women. Further particulars and forms of application may be obtained from the Assistant Secretary of the Royal Society, Burlington House, W.1.

THE John Fritz medal of the four national societies of civil, mining, mechanical, and electrical engineering has been awarded, says *Science*, to Major-Gen. George W. Goethals for his achievement in the building of the Panama Canal. The presentation was made on May 22 by Ambrose Swasey, past president of the American Society of Mechanical Engineers. Among those to whom the medal has been awarded in former years are:—Lord Kelvin, for his work in cable telegraphy; Alexander Graham Bell, for the invention of the telephone; George Westinghouse, for the invention of the air-brake; Thomas A. Edison, for the invention of the duplex and quadruplex telegraph and other devices; and Sir William H. White, for achievements in naval architecture.

HAVING held its meetings at Taunton during the period of the war, the Somersetshire Archæological and Natural History Society had hoped to hold its seventy-first annual meeting and excursions away from headquarters, but this has been found impossible owing to the difficulty of hotel accommodation. However, long excursions will be taken into Devon on this occasion, viz. to Hembury Fort, Cadhay House (1545–87), and Ottery St. Mary Church on July 30, and to Exeter on July 31. The annual meeting will be held at Taunton on July 29 under the presidency of Mr. Henry Balfour, curator of the Pitt Rivers Museum at Oxford, and past-president of the Royal Anthropological Institute. The subject of his presidential address will be "The Doctrines of General Pitt Rivers and their Influence." The outgoing president is Dr. F. J. Haverfield, who addressed the society last year on "The Character of the Roman Empire as Seen in West Somerset." The society now consists of between 900 and 1000 members, and owns a large library and the Somerset County Museum at Taunton Castle.

BY the death, at the age of seventy-two, of Sir William Macgregor, G.C.M.G., the Empire has lost a great Colonial Governor and science an ethnologist

and geographer of note. The son of an Aberdeenshire farmer, he was educated for the medical profession, and, like Cecil Rhodes, in order to save his life accepted the appointment of Medical Officer at Seychelles, Mauritius, and Fiji. Sir William Macgregor's opportunity came in 1888, when he was posted to British New Guinea as Administrator. For eleven years he was occupied in reducing the pagan savage tribes to order, and while his annual reports gave a clear account of his novel experiences, ethnologists in Europe were not slow to recognise the value of the material he had collected. He quickly realised the importance of New Guinea as the place of contact between the Melanesian and Papuan cultures, and it was largely due to his stimulus that valuable work has been carried out in this region by English ethnologists—Haddon, Rivers, Seligmann, and Williamson. After Sir William Macgregor's period of service in New Guinea he held in succession the office of Lieutenant-Governor of Lagos, Newfoundland, and Queensland, retiring from the last position in 1914. He received the honorary degrees of LL.D. from the Universities of Edinburgh, Aberdeen, and Queensland, and of D.Sc. from Cambridge, and he was a fellow of several learned societies.

The strong earthquake which occurred on June 29 in the Mugello Valley, near Florence, seems, from the few details which have reached us, to have originated at or near Vicchio, fifteen miles north-east of Florence. This village and eight others are said to have been destroyed. The shock was also severely felt at Florence, Bologna, Pistoia, Pisa, and Pontedera. The Mugello Valley is a well-marked seismic zone, though not very often in action. In 1542, 1597, and 1611 earthquakes causing considerable damage occurred in the neighbourhood of Scarperia, about seven miles north-west of Vicchio, and a fourth in 1762 near Sant' Agata, one mile farther to the north-west. In 1835 an earthquake just strong enough to fracture walls originated at or near Vicchio, and in 1843 and 1864 others of the same or slightly greater strength at Barberino and Firenzuola. There can be little doubt that the recent shock is the strongest of those which have occurred in the Mugello Valley during the last four hundred years With regard to the statement, however, referred to last week, that the earthquake is the strongest experienced in Italy since 1895, Dr. Charles Davison informs us that the authority quoted must have been referring to the Florentine district. "The last earthquake there of importance occurred in 1895. Since then there have been far greater earthquakes in Italy, such as the Messina earthquake of 1908 and the Avezzano earthquake of 1915."

In the Publications of the University of California on American Archæology and Ethnology (vol. xiv., No. 3) Mr. Llewellyn L. Loud publishes a memoir on the ethnogeography and archæology of the Wiyot Territory, lying on the shores of Humboldt Bay and the lower courses of the Mad and Eel rivers. Excavations show that among this tribe earth-burial replaced cremation. Their relation to the more northern Indians is best illustrated by the implements known as "slave-killers," though it is still uncertain whether these were actually used to kill slaves. From the little that is known of the culture of the Oregon Indians, particularly those of the Columbia Valley, we are able to trace some cultural relationship between these two groups of tribes, and it may be expected that further investigations will reveal other resemblances of these people to the Wiyot.

Mr. R. F. Barton in his account of Ifugao law, in the University of California Publications on American Archæology and Ethnology (vol. xv., No. 1), gives a valuable account of savage law. The Ifugaos of the Philippine Islands are a tribe of barbarian head-hunters, but, at the same time, they have reached a high level of material culture. Their system of terrace cultivation is specially noteworthy. One example, of which a photograph is given, is 12 km. long without a break in its continuity, and some of the terrace-walls are 60 ft. high. There is, of course, no written law literature, but their traditional social rules are most elaborate. As Mr. Barton writes:—"This people, having no vestige of constitutional authority or government, and therefore living in literal anarchy, dwell in comparative peace and security of life and property. This is owing to the fact of their homogeneity, and to the fact that their law is based entirely on custom and taboo." He adds that, before the American Government was established, the loss of life from violence of all descriptions was not nearly so great as in civilised communities.

In the April issue of the *Journal of Mental Science*, under the title of "Psychoses in the Expeditionary Forces," Capt. O. P. Napier Pearn describes the differences and similarities in the actual insanities (psychoses) found in military and civil practice respectively. Of such cases he has personally investigated 2000 at the Lord Derby War Hospital, Warrington, which up to April, 1919, had admitted 6000. All these had seen some form of service with an expeditionary force. He has collected and tabulated the facts relating to 200 cases which made a sufficiently good recovery to warrant their being returned to duty, as being those concerning whom it is easiest to obtain some form of after-history. Capt. Pearn's article is welcome as affording material with which to compare our much more extensive data of the military psychoneuroses, *i.e.* those functional mental and nervous disorders which do not constitute actual insanity. He points out how, while at the onset of a mental disorder in civil life the friends and relatives usually co-operate with the sick person in shielding him from medical advice, such a patient in the Army, owing to exigencies of discipline, is much more likely to receive attention from his medical officer at an early stage. The effect of this early care is that these cases respond to treatment in a very gratifying way. The author insists that the patient's mental re-adaptation must be aided by therapeutic conversations, giving him insight into his mental make-up in order that when he meets again with difficulties in the outside world he will be more able to surmount them. The article, while laying claim to no new discovery, lays additional emphasis upon the urgency of the early treatment of mental disorders.

In a note recently received from Prof. J. Mascart a striking cloud phenomenon seen in north-east France on July 8, 1918, is described. At 7.25 p.m. (S.T.) a wide belt of thin cirro-cumulus cloud had formed over the sky, and in this belt was traced out in the course of a few seconds a looped curve consisting of a roughly circular loop with two arms extending from it. The shape somewhat resembled the figure 6, but with the end of the ring continued out to the left hand. The curve, of a width of about a semi-lunar diameter, was marked by a complete absence of cloud in the otherwise uniform cirro-cumulus sheet, clear blue sky being visible throughout its length. The circular ring, which was somewhat flattened, was of about 20° diameter, and at an elevation of about 60–70° above the western horizon. The phenomenon remained visible for twenty-five minutes until the cloud-sheet evaporated. During this period the cloud drifted slowly from south-west to north-east, and the looped curve appeared to maintain its position

unchanged relative to the cloudlets. Prof. Mascart puts forward the interesting suggestion that the clear path through the cloud which formed the curve was caused by the passage of a small cyclone or whirl in the upper layers of the air, which by mixing caused the cloud-particles to evaporate. It thus left a track through the cloud similar to that which a tornado marks out for itself on the earth by its path of destruction. A drawback to this hypothesis is the great speed at which the curve was generated.

MONTHLY results of magnetical, meteorological, and seismological observations for several recent months, and the Annual Report for the year 1917, of the Royal Alfred Observatory, Mauritius, show the maintenance of considerable activity under the directorship of Mr. A. Walter. Information of the probable state of the weather over the surrounding area of the southern Indian Ocean to a distance of five hundred miles is supplied to shipping in the harbour daily between November and May, and during the cyclone season information, when necessary, is telegraphed to Madagascar, Réunion, and Rodrigues. From May to September cablegrams are sent weekly to the Director-General of Indian Observatories in connection with the monsoon predictions. Daily observations of rainfall are received from about 150 stations in different parts of the island. During 1917 the logs of seventy-six voyages trading in the neighbourhood were copied under the auspices of the Meteorological Society of Mauritius. This work, being carried on during the period of the war, may afford valuable information to the British Meteorological Office. The report states that "the glass ball of the old sunshine recorder having become discoloured, a new instrument was ordered"; its registers have since been used. This defect suggests extreme caution in using the sunshine values of recent years. The monthly results of observations give hourly values for most of the elements, and these show great precision. In September, 1918, there is no single day without the double occurrence of maximum and minimum atmospheric pressures, whilst other data, such as the velocity of the wind, exhibit equally regular periods.

A NEW uniaxial hydrous magnesium aluminium silicate, styled colerainite, is described by Messrs. Poitevin and Graham in a paper on "The Mineralogy of Black Lake Area, Quebec" (Canada Geol. Surv., Museum Bulletin No. 27, 1918). Analyses are given of the fine crystals of vesuvianite from the Montreal chrome pit and neighbouring localities. The variations in their habit seem connected with their colour, which ranges from colourless through yellow and emerald-green to lilac. The minerals of the district, including chromite and chrysotile, are constituents of the great belt of serpentine that extends discontinuously from Vermont across the province of Quebec. We wish it were not too late to protest against the American use of the verb "intrude" in an active sense without a succeeding preposition. We thus read in a few lines: "These igneous rocks are found intruding sediments"; "Devonian strata are not intruded"; and "the igneous rocks were probably intruded in pre-Devonian time." The second and third of these passages cannot both be correct, and the third seems the only one that should be accepted by geologists who write in English.

STATISTICS of the mineral production of India for the year 1917 have been published in the last volume to hand of the Records of the Geological Survey of India, vol. xlix., part ii. These show that the Indian mineral industry is so far in a satisfactory condition in that the value of the products has risen to 13,351,364*l.*, an increase of about 12½ per cent. on the value in 1916. In some cases this increase in value is due to a rise in the price of the commodity, which has been sufficient to compensate for an occasional falling off in the output. Nearly one-half of the total increase is due to coal, which contributes nearly one-third of the total value of the output, and in this instance it is satisfactory to note that the production has gone up by nearly a million tons to 18,212,918 tons. There was again a decrease in the output of gold by about 24,000 oz., the total yield being 574,293 oz., the decrease being almost wholly in the Kolar goldfield in Mysore. The production of manganese ore, too, has fallen from 645,204 tons in 1916 to 590,813 tons in 1917. Similarly there has been a falling off in the production of petroleum, namely, from 297,189,787 gallons to 282,759,523 gallons. On the other hand, it is interesting to note that the output of monazite in Travancore has increased from 1292·5 tons in 1916 to 1940·3 tons in 1917. The Bawdwin silver-lead mines in Burma have also increased their output, the lead produced having risen from 13,790 tons to 16,962 tons, and the silver from 759,012 oz. to 1,580,557 oz. There was a very trifling increase in the production of iron ore, and both the Tata Iron and Steel Co. and the Bengal Iron and Steel Co. were actively engaged throughout the year. Upon the whole, having regard to the difficulties under which the mineral industry laboured, the outlook for this industry in India appears to be very promising.

THE publication in March, 1917, of the regulation for preventing the misuse of the title of "engineer" in Austria has aroused great interest in Germany, where for many years abortive efforts have been made to achieve the same results. In Austria the title is now reserved for those who have studied at a technical college and passed both State examinations or taken the doctorate. The affiliation of the technical colleges to the universities was regulated by the law of April 13, 1901, giving such schools the right to confer the degree of doctor. The Austrian Society of Engineers and Architects has agitated for this protection for twenty-seven years (*Ztsch. des Vereins deutscher Ingenieure,* October 23, 1918), but the war has brought matters to a satisfactory head. In Germany it is thought a way out could be found by conferring the title "Dipl. Ing." ("engineer holding a diploma") or Engineer by Examination. The writer in the journal quoted, however, does not hold this view, and considers that no person unless properly qualified should be permitted to use the title "engineer."

A REPORT about to be issued by the U.S. Department of Commerce shows the great development of the electric light and power industry of the U.S.A. in the periods 1907–12 and 1912–17. The output of electric energy by the lighting and power stations increased at a considerably greater rate, and their expenses at a slightly greater rate, than their income. The total number of establishments in 1917 was 6541, 4224 being private and 2317 municipal undertakings. According to U.S. Commerce Report No. 84 (1919) (from which this note is taken), the total primary power in 1917 amounted to nearly 13,000,000 h.p.—an increase of 70·8 per cent. as compared with 1912. Of this power about two-thirds was derived from steam and about one-third from water, the slight surplus being obtained from internal-combustion engines. The total dynamo capacity in 1917 was, roughly, 9,000,000 kw., 74·3 per cent. more than in 1912; while the output of energy aggregated 25,500,000 kw.-hours, an increase of 119·9 per cent. for the period 1907–12. It is stated, incidentally, that incandescent electric lamps are rapidly exceeding arc lamps for street lighting.

In a paper published in the June issue of the Journal of the Franklin Institute Gen. Squier describes experiments made on the use of trees as antennæ in radio-telegraphy and radio-telephony. He discovered in 1904 that certain trees, especially eucalyptus trees, could be usefully employed as antennæ. Owing to the dryness of the season and the nature of the soil at his camp in California, the regular Army "buzzer" telegraph and telephone sets were inoperative. When, however, they were connected to a nail driven into the trunk or roots of a tree they worked satisfactorily. During the war experiments were made on the efficiency of growing trees as antennæ. With modern sensitive amplifiers it was discovered that it was possible to receive signals from the principal European stations by simply laying a small wire netting on the ground beneath a tree and connecting it by an insulated wire to a nail driven in near the top of the tree. Instead of the wire netting, a few insulated wires buried a few inches in the ground were found to answer perfectly. Interesting tables are given showing the resistance and capacity of the conductor for various heights of the nail, and also by indirect methods—the open-circuit voltage—induced in the conductor.

The Proceedings of the Physical Society for June 15 contains as an appendix, which has been issued separately, a report of the discussion on metrology in the industries which took place at the meeting of the society at the end of March. The discussion was opened by Sir Richard Glazebrook, and many manufacturers and others who had been concerned in the use of gauges in testing the accuracy of munition work turned out during the war took part in it. One of the most important facts brought out in the discussion was that many works which, by the use of gauges, were enabled to turn out work of a much higher order of accuracy than they had ever thought possible were now reverting to the old rule-of-thumb methods. Since quantity production and interchangeability are likely to prove essential features of the work of the future, it was suggested that this reversion should be so far as possible prevented by the issue of gauges in which the difference of size of the "go" and "not go" was considerably greater than in those used in first-class work. By this means the valuable principle of working to gauge could be retained even for the rougher work, and any future increase of accuracy which might be necessary would involve nothing more than a change of the gauges in use.

The interesting new method of X-ray analysis initiated by Debye and Scherrer has been employed by A. J. Byl and N. H. Kolkmeyer to investigate the structure of ordinary white tin and the second variety of this metal known as grey tin, and an account of their work is published in the Proceedings of the Academy of Sciences of Amsterdam (vol. xxi., 1918). The method is eminently suitable for metals not available as single crystals, and for micro-crystalline substances in general. An X-ray tube with copper anticathode was used, the rays leaving the tube by an aluminium window. They passed thence through a narrow aperture in a thick leaden screen into a cylindrical camera. The tin lay in the axis of the cylinder in the form of a narrow bar, in one case of white hammered tin, and in the other of compressed grey tin. A photographic film, on which the interference lines were found after development to have been produced, was stretched against the wall of the camera. The interference lines resulting with grey tin showed at once that this variety of tin is also crystalline, and that the crystals belong to the cubic system. There appear to be eight atoms of tin to an elementary cube, which corresponds with the same structure as that of the diamond, and also with that of silicon. The tin in this form is obviously tetravalent. Ordinary white tin, according to Miller's measurements with electrolytic crystals, is tetragonal, and this fact is confirmed by the interference lines found in the experiments with the bar of this variety of tin. There appear to be three atoms to the elementary cell of the space-lattice, an atom lying at each corner of the tetragonal cell and one in the centre of each of the four prism faces of the cell, but none in the centres of the two basal-plane faces. This structure corresponds with atoms exhibiting prominently two valencies only. It would thus appear that grey tin possesses a structure corresponding with the exercise of the full tetradic valency of tin in the stannic salts, and ordinary white tin a structure corresponding with the exercise of its dyadic valency in the stannous salts.

The first number of a new chemical journal, the *Chemical Age*, was issued on Saturday, June 21. The journal is to appear weekly, and to be devoted to industrial and engineering chemistry. It is now nearly five years since the *Chemical World*, a journal with corresponding intentions in regard to chemistry and chemical engineering, ceased to exist after the production of three volumes. Many people regretted its demise, for it was full of interesting matter and well got up, but the cause of its early failure was probably the fact that there was only a monthly issue, and something was wanted to keep pace with the current of events, rapid even before the war. This is more than ever true at the present time, when it may be said that the British manufacturer and the British public are at last waking up to the necessity of associating science with industry. The new journal has a larger page than the *Chemical World* or any of the other technical chemical journals, and is brought out at the moderate price of 21*s.* per annum, or 6*d.* a week. The first issue contains a number of interesting expressions of opinion from public men, including Mr. H. A. L. Fisher, Lord Sydenham, and well-known experts, including Sir Edward Thorpe, Col. Brotherton, Mr. James Swinburne, and others, in regard to the future of British chemical industry. On this subject there can be little difference of opinion, if only the same energy and skill already displayed continue to be employed and foreign competitors are excluded, at least for a time. The issues of the *Chemical Age* which have appeared so far contain matter of importance to every practical man connected with chemical industry, and we wish the new venture full success.

Some analyses and tests of rigidly connected reinforced concrete frames are given in the University of Illinois Bulletin (vol. xvi., No. 8). The author, Mr. Mikishi Abe, derives formulæ for a number of such frames by the method of least work. Test frames were then designed according to the formulæ, and the experimental results were compared with those obtained by calculation. It was found that the elastic action of the frame and the manner of stress distribution agree fairly well with the analyses; that the locations of the points of inflection agree closely with the calculated positions; and that in carefully designed frames there need be no anxiety as to the rigidity of the joints, since effective continuity of members was found in the tests. There is a number of other deductions from the results which will be of service in design, and it would appear that the formulæ derived by analysis may be applied to a variety of forms of frames and are of wide applic-

ability. Altogether, this bulletin constitutes a valuable contribution to our knowledge of reinforced concrete frames.

Messrs. Baillière, Tindall, and Cox are adding to their Industrial Chemistry Series "Animal Proteids," H. G. Bennett; "The Carbohydrates," Dr. S. Rideal; and "The Industrial Gases," Dr. H. C. Greenwood. The *Cambridge University Press* will shortly publish "An Enquiry concerning the Principles of Natural Knowledge," Prof. A. N. Whitehead, which will be divided into four parts, dealing respectively with the Traditions of Science, the Data of Science, the Method of Extensive Abstraction, and the Theory of Objects. *Messrs. G. G. Harrap and Co.* are publishing immediately "Physical Chemistry," Prof. A. T. Lincoln, and "An Introduction to Chemical German," E. V. Greenfield, with an introduction, notes, word-lists, and a vocabulary of German chemical terms. *Messrs. Longmans and Co.* have in the press "Elements of Vector Algebra," Dr. L. Silberstein. *Sir Isaac Pitman and Sons, Ltd.*, have just begun the publication of "Pitman's Technical Bookshelf." It is a record of their forthcoming and recent publications in science and technology, and contains also brief abstracts of articles from the technical Press. We learn from it that the following books may be expected shortly:—"Gas and Oil Operation," J. Okill; "Storage-Battery Practice," R. Rankin; "A Preparatory Course to Machine Drawing," P. W. Scott; a new edition, the fourth, of "Whittaker's Electrical Engineer's Pocket-Book," edited by R. E. Neale and completely re-written; and a new and enlarged edition of "Poole's Practical Telephone Book." *Messrs. J. Wheldon and Co.* have nearly ready "A Synoptical List of the Accipitres or Diurnal Birds of Prey," part i. (Sarcorhamphus to Accipiter), H. Kirke Swann. The edition is limited to 200 copies, only 100 of which will be offered for sale. *Messrs. Witherby and Co.* have in the press part i. of "A Geographical Bibliography of British Ornithology" (arranged under counties) from the earliest times to the end of 1918, W. H. Mullens, H. Kirke Swann, and the Rev. F. C. R. Jourdain. The work will be completed in six parts.

The catalogues of Messrs. J. Wheldon and Co., 38 Great Queen Street, W.C.2, are always worthy of perusal. The latest one (new series, No. 87) is especially so, being a very complete and classified list of nearly three thousand books in zoological science arranged under the headings of Protozoa and Rotifera; Annelida; Hydrozoa, Polyzoa, Spongia; Echinodermata; Crustacea; Insecta; Mollusca; Marine Biology; Parasitology, etc.; Pisces (including Fisheries); Reptilia and Batrachia; Aves; Mammalia (faunas); Cetacea and Pinnipedia; Domestic Animals; Primates (and Man); General Zoology; Natural History; Biology, Anatomy, etc.; and Evolution, Heredity, Hybridity. Many very scarce works are included. The catalogue is certainly one to be consulted.

OUR ASTRONOMICAL COLUMN.

The Eclipse and Wireless Telegraphy.—It will be remembered that a programme of observation was arranged to detect possible effects of the eclipse of May 29 on the transmission of Hertzian signals, and an interesting experience of this nature is reported by the French military radio-telegraphic authorities. There is at the observatory at Meudon a wireless reception apparatus, which on the day of the eclipse was arranged to receive the special signals sent from the Island of Ascension. It has been found that wireless messages from that place can be heard by night, though not by day, but during totality, when the shadow projected by the moon passed between Ascension and Meudon, the signals from Ascension were heard strongly. They then decreased in intensity, and ceased completely when the eclipse ended.

The Parallax of the Pleiades.—Prof. Kapteyn has proposed (Contributions Mount Wilson Observatory, No. 82) an indirect method of finding the mean parallax of the stars of a cluster by counting the number of stars of different magnitude it contains. The method requires a knowledge of the law of distribution of stars of different luminosity or absolute magnitude in the cluster, but if this is known, since apparent magnitude is a function of luminosity and parallax, it is possible to evaluate the latter from the data by formula. Dr. W. J. A. Schouten, of Aalten, Holland, is applying this principle to find the distance of star clusters, and gave thirteen of his results in the *Observatory* for March, the parallax of Præsepe being 0·024″, and the largest of the remainder 0·004″. He continues this in the June issue by giving details of his research on the Pleiades, and incidentally gives a valuable list of existing catalogues of the group. From the counts of stars of different magnitudes in five of these, in combination with a luminosity curve formed by Prof. Kapteyn, he deduces five values of the parallax which are in close accordance, and give a mean value 0·036″, with a probable error ±0·010″. Former determinations by Prof. Kapteyn and Prof. Plummer by other indirect methods gave 0·018″ and 0·024″ respectively. Dr. Schouten is encouraged to think that the comparative accordance of the results is some confirmation of his method.

Painting the Corona.—On the occasion of the total solar eclipse of June 8 last year (1918), which was observed with some success from stations in the United States, an unusual effort was made to obtain a picture of the phenomenon in its true colours. Mr. E. D. Adams, of New York, a benefactor to science, who joined the U.S. Naval Observatory eclipse party, took the responsibility for this, and, as colour photography was out of the question, enlisted the services of Mr. Howard Russell Butler, a portrait painter of repute, who has developed a shorthand method of noting both form and colour. Having prepared a drawing card with circles, radii, and angles marked, and having made himself mentally familiar with the kind of picture that might be seen, Mr. Butler utilised the 112 seconds of totality at his disposal by making a rapid sketch of the corona and prominences as he saw them, and wrote numbers on points and regions to indicate their colour according to his numerical colour-scale. The artist's first drawing was afterwards amended as to contours of luminosity by comparison with photographs, and then completed. The painting, which shows not only the prominences and corona, but also the sky around, was exhibited at the American Museum of Natural History, and a copy forms the frontispiece to *Natural History*, the journal of the museum, for March last.

THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

The second British Scientific Products Exhibition promoted by the British Science Guild was opened at the Central Hall, Westminster, on Thursday, July 3, and it will remain accessible to the public until August 5. It will be remembered that the first exhibition was held in King's College last August, but owing to the arrangements of the college, due to demobilisation, it was found impossible to hold the present exhibition there. Last year's exhibition was

afterwards transferred to Manchester, and it proved eminently successful in carrying into the provinces a knowledge of the recent achievements of British science and industry.

This year's exhibition was declared opened by the Marquess of Crewe in the presence of a representative company of scientific and technical workers. In his opening address Lord Sydenham, who occupied the chair, referred at some length to the important part played by British science and industry in the victory which has so recently crowned the Allied efforts. We proved ourselves superior to the enemy in every technical art, and but for the splendid co-operation of the leaders of science and industry our Army would have fought in vain.

In declaring the exhibition opened the Marquess of Crewe emphasised the difference between the present exhibition and the one held at King's College last year. The latter took place at a time when the result of the war was still doubtful, although the tide of battle was flowing strongly in our favour. Necessarily, therefore, it gave precedence to industries engaged primarily in the service of war. The present exhibition, on the other hand, is meant to show the triumphs of British industry in the arts of peace, and to bring home to the general public the importance of the relationship between science and industry, and also between education and research.

In this connection Lord Crewe dwelt on the desirability of introducing definite industrial courses for university students in technology, such courses to be taken in vacations at suitable works connected with the particular study the student is undertaking. Such an arrangement has worked with great success in the United States. The institution of industrial fellowships for post-graduate students attached to one or other of the universities would also have an important influence in keeping industries in touch with modern scientific developments, and, in addition, provide the country with highly trained technologists. The Department of Scientific and Industrial Research is endeavouring to do something on these lines by urging the establishment of industrial manufacturing associations which will carry on research in some particular technical branch.

The exhibits themselves are almost bewildering in their comprehensiveness. Practically every phase of British industry is represented, the various exhibits being divided into the following eleven sections:—Mechanical Science, Physics, Textiles, Electrical Appliances, Medicine and Surgery, Paper and Illustration, Agriculture, Chemistry, Aircraft, Fuels, and Metallurgy. Naturally, it is impossible to do more than touch superficially on the different groups.

In the Mechanical Science section G. Cussons, Ltd., of Manchester, are exhibiting various types of projection apparatus for testing form, profile, and screw-thread gauges. These instruments were devised at the National Physical Laboratory, and they have played an important part in the accurate and rapid testing of gauges which is so essential in the quantity production of machined parts. The Foster Instrument Co., of Letchworth, shows some interesting testing machines, including a modification of Dr. Stanton's impact testing apparatus, and also a notched-bar machine which yields a graphic record giving the history of the breaking of the specimen. A model of the first vessel to be fitted with Parsons marine turbines is shown by the Parsons Marine Turbine Co., and also a model exhibiting the interior of an engine-room of a two-shaft arrangement of Parsons geared turbine machinery.

In the Physics section Messrs. Hilger show some beautifully designed apparatus, including spectroscopes, polarimeters, and interferometers. The Meteorological Office has an exhibit of some excellent photographs and diagrams, and, in addition, some recently designed instruments for the determination of meteorological data. There are also some noteworthy exhibits of optical glass, and the items in the photographic section deserve more than cursory examination.

The latest thing in range-finders is shown by Messrs. Barr and Stroud, of Glasgow. The 30-ft. instrument is a triumph of both mechanical and optical skill. In something less than three seconds a range of ten thousand yards, with an error of less than twenty-one yards, can be signalled to the gun. For the direct reading of the range in these instruments some very fine gears have been designed. The anti-aircraft range-finder, where height, distance, and angle have to be determined rapidly, is a marvel of ingenuity and workmanship. The submarine periscopes, the watertight-door electric indicators, and the optical glass exhibit of this firm also call for special attention.

The Electrical section embraces the whole range from electric cooking to wireless telephony. Messrs. Marconi show a portable direction-finder and a small wireless telephony set; Messrs. Vickers show their magnetos, which have played such an important part in our aerial supremacy; and Everett, Edgcumbe, and Co. display a very fine selection of electrical measuring and controlling apparatus.

The Chemistry section bears eloquent testimony to the fact that in this branch of industry we have little now to learn from Germany either on the scientific or industrial side. We can produce our own laboratory glassware, our own filter-papers, our own analytical reagents, our own indicators, and our own drugs. Levinstein's, Ltd., again show the remarkable progress we have made in the dye industry, and quite a number of firms prove what can be done in the production of organic and inorganic compounds. The exhibit of the South Metropolitan Gas Co. emphasises the importance of coal-tar in the chemical industry.

The A.I.D. exhibits a representative collection of metallic and non-metallic materials employed in aircraft construction, together with a range of aeronautical instruments and equipment, models, and testing apparatus. The most interesting feature, perhaps, is that showing the most recent developments of the all-metal aeroplane. The instrument section is also of great importance, and, perhaps more than any other branch, shows the necessity for the trained physicist in industry.

Examples of recent developments in both ferrous and non-ferrous products are to be found in the section devoted to Metallurgy. Some interesting furnaces for heat-treatment purposes are also shown. In the refractory material section the Morgan Crucible Co. shows what can be done in the manufacture of the latest types of crucibles. Messrs. Hadfield exhibit a model of the largest armour-piercing shell in the world. This is of 18-in. calibre, and weighs about $1\frac{1}{2}$ tons. The same firm shows a 17-in. hardened steel roll for the cold rolling of metals. This important key industry has now been entirely captured from Germany.

Displays of kinematograph films of scientific and technical interest are being shown at the exhibition from 3.30 to 5.30 p.m. on the following dates:—July 15, 17, 22, 24, 26, 29, and 31. The films illustrate (1) aircraft construction and utilisation, (2) the making of a big gun, (3) the water powers of Canada and their industrial utilisation, (4) wireless telegraphy and telephony, and (5) magneto construc-

tion. On Monday last a lecture on Chemistry in Reconstruction was given by Sir William Tilden, and yesterday Prof. W. H. Bragg lectured on Sound under Water and its Applications. The following lectures will be delivered at 5.30 on the dates named:—July 11, Coal Conservation, Prof. H. E. Armstrong; July 14, Progress in Range-finders, Prof. Archibald Barr; July 18, Explosives, J. Young; July 21, Progress in Aviation during the War Period, L. Bairstow; July 23, How the Cotton Plant Feeds as well as Clothes Us, S. E. de Segundo; July 25 (6 p.m.), A Few Thoughts on the Development of London, Raymond Unwin; and July 28, Scientific Lighting and Industrial Efficiency, L. Gaster.

STRONG ELECTROLYTES AND IONISATION.

IT is well known that the behaviour of strong electrolytes is very difficult to reconcile with the usually accepted theory of ionisation, in that the change of the degree of ionisation with the concentration is completely at variance with the requirements of the law of mass action. The abnormality of this very important group of substances is discussed in a series of papers by J. C. Ghosh (Journ. Chem. Soc., 1918, vol. cxiii., pp. 449, 627, 707, 790), who contends that the fundamental idea underlying the Arrhenius theory is not applicable to strong electrolytes. In place of this theory the author puts forward the view that the strong electrolytes are completely ionised, and that there is no question of the existence of non-ionised molecules in the usually accepted sense. The relations between the ions are controlled by the electrical forces, the magnitude of which corresponds with a certain potential which is characteristic of a given solution of an electrolyte. This potential affords a measure of the work which is required to free the ions from the influence of their mutual forces. Kinetic considerations suggest that the ions become "free" when their velocity exceeds a certain critical value, the fraction of the ions in this condition at any moment being shown by the ratio of the conductivity of the electrolyte in the given solution to the conductivity at infinite dilution. Assuming that the marshalling of the ions in solution corresponds with the arrangement of the atoms in the crystallised electrolyte, the author derives an expression for the characteristic potential in terms of the ionic charge, the dielectric constant of the medium, and the dilution of the solution. By introducing the Clausius virial theorem, the connection between the proportion of free ions and the osmotic ratio is deduced, and this relation differs notably from the well-known equation based on the Arrhenius theory. Experimental data relative to the influence of concentration, temperature, and solvent on the conducting power of strong electrolytes are shown to be in accord with the author's hypothesis, which is developed in the last paper of the series so as to account for the abnormally high speeds of the hydrogen and hydroxyl ions, for which no satisfactory explanation has yet been given.

THE FISHERIES AND THE INTERNATIONAL COUNCIL.[1]

II.

WE now come to the consideration of the hydrographical, meteorological, and physical work of the International Council in relation to the fisheries problems put before it. Out of a total of seventy fascicules of the "Publications de Circonstance," no fewer than thirty-one belong to this section, and this in an inquiry specially devoted to the food-fishes. Besides, there is a great bulk of large quarto hydrographic and planktonic volumes which far exceeds anything else in the Council's publications. The special value of these to hydrographers does not concern the present criticism, but considerable dubiety surrounds the attempt to connect, for instance, oceanic currents with the eggs, larvæ, and young of the fishes, especially when, in their own words, such gives "some notion of how very complicated the question of the passive movements of the pelagic stages under the influence of the currents really is, and how it assumes a different form in each species." This view takes for granted that the larvæ and young are as passive as the eggs—a supposition dealt with long ago. Secondly, in other words, there are special currents which keep and carry the eggs and larvæ of the haddock annually to deep water, and others which bear with unfailing regularity the young cod shorewards; likewise others, with similar annual rhythm, sweep the larval and post-larval frog-fishes from their floating ribands of gelatinous mucus to deep water, along with such vagrant larvæ of the skulpin as have been hatched near the shore; still others which take the young plaice during the change of the eye to the beach and, with nice discrimination, leave the long rough dabs and a number of dabs in deep water in the neighbourhood of their birthplace.

It would be interesting to inquire for the special currents which distribute the young of the viviparous Norway haddock in the open water, or for those which pass by the young of the viviparous blenny in the rock-pools, or, by way of variety, for those motionless waters which leave the young herrings, like a carpet of threads, over square miles of the inshore waters, and for those special currents which invariably plant the young wolf-fishes, after their escape from the huge masses of large adhesive eggs, on rough ground. The hydrographers have, moreover, overlooked the "currents" which carry fishes and invertebrates hatched on the bottom to the surface of the water, and those, when they are older, which carry them down again. They have missed those discerning currents which, in the case of the ubiquitous pelagic eggs of the rocklings, convey some shorewards and send others to the deeper water. Moreover, they have forgotten the variable action of the winds in modifying the currents.

Briefly, each species would thus appear to have a current to itself and adapted to its special needs—a supposition which cannot be accepted. The case of the North Sea Bank is given, in illustration, as a spawning area from which the small larvæ are distributed over the whole deep part of the Skagerak, the Norwegian channel and sea. It is stated that "typical tidal movements have been demonstrated in the North Sea, the resultant movement of which is often different in the different depths. This might possibly be sufficient to separate the eggs in one layer from those in the other. For the rest, this disposition is naturally very different in the different parts of the North Sea." Such uncertain groping for an anchorage of an important science in the fisheries is unworthy of it. Support is drawn by the Council from Johs. Schmidt's observations in Iceland, already mentioned, but these might readily be interpreted otherwise. An interesting local case, however, is that of the Atlantic current in the Baltic Sea, where it forms an intermediate one between the top and the bottom, and, it is said, the eggs of plaice have alone been found in it as far as Bornholme. The adults pass higher up, but it is suggested that they come back to spawn there. These observations would require confirmation, and, in any case, cannot hold for the plaice of the North Sea

[1] From a lecture given in Aberdeen on March 4 by Prof. McIntosh, F.R.S. Continued from p. 358.

generally, though it is stated that a similar condition exists in the southern North Sea.

The notions about fishes tending to accumulate about "the meeting of the waters," the spreading of water of low salinity from the Baltic over the North Sea, and the entrance of a little of the Gulf Stream at either end may be interesting, but it is more or less fanciful to say: "The direct influence of this system of currents on the life of the fishes is immense, for by its means their floating eggs and young are dispersed or disseminated broadcast. In the south those of the plaice and sole are carried over to their nursery grounds on the flat Danish shore, and in like manner the eggs and fry of the cod are drifted from the western coasts round the north of Scotland, and in part out again to the sea of Norway." Unfortunately for this romance, the eggs and young of the spawning plaice of our eastern shores float, drift, and swim in myriads to the tidal margin there. The eggs and young of the spawning cod off the Isle of May follow a similar course, the young appearing in numbers amidst the tangle-forests inshore in June, whilst the eggs and young of the haddock seek the deeper water offshore, the young only appearing inshore when 5–6 in. in length. Again, the eggs and young of the sole find another home than that on the Danish shore, and for hundreds of years have swarmed, and swarm now, in the estuary of the Thames and other parts of the southern coasts. All this, and much more, takes place irrespective of the endless text-figures of currents—circling as well as sinuous and straight—and also of endless columns of temperatures and salinities, the production of which has absorbed so large a share of the time and funds of the International Council.

The day has not yet come for so simple a solution, which, moreover, does not fit in with the herring either in its larval, post-larval, young, or adult condition. High hopes sprang up in some quarters from the so-called "classical" instance of the herring in the Skagerak and Kattegat, the abundance or scarcity of which, as well as of the fisheries generally of southern Sweden, was said to depend on the ebb and flow of a layer of cold salt water; but these comparatively narrow entrances differ much from the North Sea, just as the Baltic herring differs from that of the open ocean. These high hopes have not been realised after the sixteen years' labours of the international workers in the North Sea. Currents, temperatures, alkalinities, and salinities cannot alter the original instincts of a food-fish.

The western waters of Scotland, again, differ from those of the eastern shores, and the fish-fauna is supposed to differ considerably in the two areas; yet herrings frequent both, as likewise does the green cod, whilst the common wrasse represents in the east the swarms of the same group in the western lochs. Both are frequented by the salmon, by the conger, and by the dog-fishes, and the littoral belts have many fishes in common.

The sum-total of the labours and heavy expenditure of the hydrographical department up to date, and in relation to the task entrusted to the International Council, is very much as it was in 1907, but it is only right to state that the several reports from which the Council drew its conclusions all display the energy and resource of the observers in carrying out their tasks in the North Sea. The criticism applies to the summary of the Committee.

From a survey of the whole work of the International Fisheries investigations, and with the most generous interpretation of the labours of the various workers, who have in many cases advanced our general knowledge of the life-histories and distribution of the food-fishes, it cannot be said that they have settled the main questions (already stated) they were appointed to solve, viz.: "Whether the quantity and consumption of fish taken from the North Sea and neighbourhood are in proper proportion to the production occurring under the prevailing natural conditions, and whether any disproportion between production and consumption arises from a local over-fishing or from an injudicious employment of the fishing apparatus at present in use." They are as uncertain now, notwithstanding all the official explanations, as they were at the beginning; whilst during those sixteen years the views of some have been kaleidoscopic, and ever calling for longer time and for further investigations. It is true that fewer large plaice are caught on an oft-trawled area, as has frequently been pointed out, but the swarms of young which the same records demonstrate are a sufficient guarantee for the future. After these labours to combat the views expressed in 1898, the Council concludes with but a single recommendation, viz. protection of the plaice, as detailed on p. 7. It observes: "(1) It is very probable that the density of the plaice shoals has decreased in a notable manner, and the absolute size of the plaice-stock thus diminished; (2) that the diminution of the plaice-stock has not affected all size-classes in an equal degree, but especially the larger and older plaice. This appears in the catches and landings from a relative reduction in the number and weight of the large, and increase in the small, plaice, as well as from a decrease in the average size of the plaice."

In other words, all that can be said is that plaice are not less numerous, but, according to the methods of the Council, they are smaller—a finding which leaves the plaice in safety. The larger plaice frequent the deeper water, where it is less easy to capture them, and that a sufficient number survive to keep up the stock of the smaller plaice the Council freely admits in every case by the mention of swarms of young, even on the oldest fishing areas. Besides, many years' longer experience of typical plaice grounds on open borders shows that the efforts of man—by net, hook, and trawl—fail to make any serious impression on the multitudes of the younger forms. Similar experience may be found in the older official records, and, further, years of decrease of the plaice-fishing have been followed by years of substantial increase; so that the steps for what was called "concerted international action" were arrested. The idea that the North Sea can be fished out is chimerical, for even if it were all gone over thrice or more frequently a year, such could not produce depletion or exhaustion of its fisheries—plaice included. Besides, 13 per cent. of its area cannot be trawled, and, with the northern and other increments, that is sufficient to maintain its resources.

For sixteen years the answer to the problems submitted to the International Council has been waited for, and yet it is as far distant as ever; nor does it appear that anything more definite will arise from these expensive experiences—which do not seem to be even salutary.

If the able international investigators had, indeed, searched the various areas in the North Sea themselves, or if the Council had completed an arrangement for the uniform collection of fishery statistics by all the countries bordering on the North Sea, a great advance would have been made. Further, it may be asked: What has the Council done "to discover the limit to which fishing grounds can be depleted without undergoing serious injury"; in proving that in a given area the larger forms are permanently diminished by constant trawling; in discovering whether in such areas the fishes become more wary; in showing that the shoals are thus driven from a particular ground; in demonstrating the effects of

sudden changes in the methods of capture; and in deciding as to the value of sea-fish hatcheries? The expenditure of more than 100,000*l.* by this country alone has not enabled the Council to grapple with the constantly recurring complaint about the decadence of the sea-fisheries, or to fulfil the promises which heralded its appointment; yet the expenditure continues, and, to judge by the character of the publications forthcoming, the fundamental facts required are still in abeyance, though, it is true, the impoverishment of the sea is now seldom mentioned, whilst the facts in relation to the soundness of the views in "The Resources of the Sea" have been augmented. That at least is a gain.

The foregoing views as to the safety of the sea-fishes of our country have long been held, and from a different point of view, by such distinguished men as Prof. Huxley, Lord Eversley, and Sir Spencer Walpole, besides others of more modern date. Lord Eversley's recent papers are a sufficient answer to those who wrongly asserted that Prof. Huxley, his old colleague, changed his opinions.

If but a fraction of the great expenditure had been devoted to marine laboratories, where personal contact of the workers with the sea and its fisheries would have laid a sure basis for original work in this and cognate departments of marine research, there can be little doubt that the country would have been better served. It seems a paradox that a Secretary for Scotland, the same who in 1898 refused an offer for the repetition on the same areas of the trawling experiments of 1884, should challenge and withdraw an annual sum of less than 100*l.* for the upkeep of a marine laboratory where much of the pioneer scientific fishery work in this country was done, and yet countenance this costly international enterprise which has ended in results so uncertain and so disappointing in many respects to the nation, and gave facilities to the Germans for familiarising their seamen with the coasts of the North Sea for other than fishers' work.

Finally, the day will soon come, if it has not already done so, when such crude notions as to the impoverishment of the sea-fisheries will utterly lapse, and, whilst safeguarding the yield of the sea by every reasonable measure, the authorities and the public will place implicit confidence in the resources of the ocean and the ways of Nature therein; and these conclusions apply, not only to the North Sea, but also, in the main, to all the great sea-fisheries of the world, including those of Canada, the Cape, Australia, India, New Zealand, the United States, France, Japan, Russia, Norway, Sweden, and, with modifications, to those of the countries bordering on the Mediterranean. The closure of large areas of the sea rests on no scientific basis, though it may be politic in the interests of certain classes of fishermen; and there can be no doubt that the public, by such closure, is deprived of a large and perennial supply of fishes of easy capture—for instance, from the Moray Frith. If a small bay like that of St. Andrews can defy the local and immigrant fishing-vessels of all kinds, and hold its own even on a narrow strip, what permanent effect can the mere scraping of about three-fourths of the North Sea (Moray Frith included), with its 140,000 square miles, a few times a year have on its fish-fauna, especially when it has a considerable area of untrawlable ground, not to allude to the belt within the three-mile limit, or to the vast increment of young fishes it receives from the north, and more sparingly from the south? The stability of "The Resources of the Sea" as regards food-fishes does not rest on a single fact, but on all the facts, and on an unbroken chain from the simplest plants and animals through all the various grades up to the food-fishes; and this stability remains unshaken after the efforts of the International Council and its investigators, some of whom still continue to pin their faith to the mechanical manipulation of statistics of the catches at various ports.

What was said in 1907[2] has additional force to-day, viz. it is indeed fortunate for this and other nations that the unbroken chain of circumstances combines to render the sea-fishes so capable of holding their own, not only in former geological periods, when, for instance, the gigantic fish-eating Ichthyosauria traversed the seas from pole to pole, but also to-day. For what alternatives are before us?

Artificial hatching, while admirable in fresh-water and anadromous fishes, has not been proved (and this is said with all deference to the efforts of the Americans, our own countrymen, and others) to be of actual service in marine fishes, the young of which are everywhere so numerous. Besides, the heavy expenditure would ill be borne by the taxpayers when the foreign fishermen share equally with their own.

Transplantation could readily be carried out, especially with flat-fishes, though under the same international disadvantages; yet Nature in the open waters needs little aid in this respect.

More might be said in favour of a size-limit, but that more has much of sentiment in it; for whilst the ordinary fisherman dare not sell his small fishes, and could not eat them, many—indeed, almost all those hooked, and a larger or smaller proportion in the trawl—would perish. But what would the Legislature make of the destructive shrimper, who cares neither to sell nor to eat the small fishes? Moreover, it is hollow legislation which imposes a penalty in the case of small flat-fishes, and is purblind to the destruction of small round-fishes.

To him who revives and nurses the barren fears and doubts of many centuries, and to the disciple of "The Impoverishment of the Sea," there is thus little comfort in the sound of alternatives.

On the other hand, the plenitude and the endurance of the sea-fishes are marvellous, yet true. Nature is even prodigal in their vast abundance and variety. Indeed, it is by no means certain whether the combined destruction caused by invertebrate marine animals, from the democratic jelly-fish (Pleurobrachia) to the predatory cuttle-fish; by the food-fishes themselves, many eating their smaller brethren or the young of their neighbours, even the herring swallowing dozens of the floating eggs of the white fishes with its food; by voracious fishes like sharks, dog-fishes, and skate; by the vast army of piscivorous birds; by the multitude of whales, single and social; and by the seals—I repeat, it is by no means certain whether this combined destruction does not equal, if not exceed, in numbers at least, that of man himself.

Let us then be chary of futile international or other expenditure in search of a phantom, but at once organise the scientific staff of each centre of the kingdom on a modern (*i.e.* apart from agriculture), effective, yet not costly footing, and, whilst vigilant in guarding the national trust and in checking any avoidable waste of fish-life, let every well-conducted method of capturing the sea-fishes be free from unnecessary restrictions. The unparalleled services of both liners and trawlers to the country during the late crisis merit no less.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—The following degrees in science have been awarded:—*Doctor of Science:* J. E. Coates, C. K. Brain, Blanche Muriel Bristol, Nellie Carter, Alfred John Grove, Leslie Herbert Lampitt, and C. M. Walter. *Master of Science:* Daisy Louisa Ibbs,

[2] Lecture II., Royal Institution, p. 19.

Helena Charlotte Chance, C. A. F. Hastilow, R. H. Humphry, A. M. Mehrez, Abd El Rahman El Sawy, and Mostapha El Sayed.

The following appointments to vacant chairs have been made:—Dr. John Robertson as professor of hygiene and public health, Dr. John Shaw Dunn as professor of pathology, and Mr. Leonard Gamgee as professor of surgery.

Prof. Haslam has been appointed lecturer in applied anatomy.

Prof. Peter Thompson has resigned his office as Dean of the faculty of medicine, and Prof. Haslam has been appointed to succeed him.

Mr. William Haywood has been appointed lecturer in town-planning.

Mr. B. T. Rose has been appointed demonstrator of anatomy, and Miss Hilda Walker lecturer in physiology.

CAMBRIDGE.—Mr. C. T. R. Wilson has been appointed reader in electrical meteorology.

LONDON.—The following have been appointed to lectureships in the subjects indicated, tenable at University College:—*Faculty of Science:* Mr. J. C. Flügel (psychology), Mr. E. J. Salisbury (botany), Dr. Paul Haas (plant chemistry), and Dr. Francis W. Goodbody (medical chemistry). *Faculties of Science and Engineering:* Mr. H. T. Davidge (applied mathematics). *Faculty of Engineering:* Mr. C. C. Hawkins (electrical design).

The Senate of the University has instructed the Principalship Committee to proceed to recommend one or more persons for appointment to the position of Principal Officer. In 1915 the University advertised the appointment and certain applications were received, but the Senate did not then proceed to fill up the vacancy. Applications already received, together with any other names which may be brought to the notice of the Senate, will be considered by the Principalship Committee.

APPLICATIONS are invited for a Lee's readership in chemistry (with special reference to the inorganic and physical sides of the subject) at Christ Church, Oxford. The stipend to begin with will be 450*l.* annually. Applications for the appointment must be received before September 10 by Mr. R. E. Baynes, Christ Church, Oxford.

APPLICATIONS for not more than three Ramsay memorial fellowships for chemical research will be considered by the trustees at the end of the present month. The value of each fellowship will be 250*l.* annually, with the possible addition of not more than 50*l.* for expenses. The fellowships will be tenable for two years normally, and may be extended to three years. Applications must be made to the organising secretary of the Ramsay Memorial Fund, University College, Gower Street, W.C.1, not later than July 14.

THE Merchant Venturers' Secondary School, which has been conducted for many years as a part of its technical college by the Society of Merchant Venturers, an ancient Bristol guild, will at the end of the present term be transferred to the Bristol Education Committee, and will become a municipal school. The Merchant Venturers conduct in their college the faculty of engineering of the University of Bristol, and the urgent need for additional space for this rapidly growing faculty has made it impossible for them to continue to house the secondary school.

THE special feature of the July issue of the "Readers' Guide," published by the Norwich Public Library (post free 2*d.*), is a classified and annotated list of books and articles on the important subject of coal and the nationalisation of coal-mines, which should be of much practical use at the present time. The list comprises a representative selection of the principal writings on the subject, and is divided under the following headings:—Bibliography; Natural History; Legislation; General and Economic, with a subdivision "Books for Juveniles"; Conservation; Statistics; Reports of Royal Commissions, etc.; Nationalisation; and Mining.

LONDON will now come into line with the newer universities in having a faculty of commerce, which it is proposed to open on October 1. The general plan for degrees in commerce was first put forward about a year ago, and the scheme which is about to be put into operation is the result of long deliberations between prominent City men and the University authorities. For the present, provision has been made for granting two degrees—the B.Com. and the M.Com. Certain subjects will be compulsory for the former, viz. economics, banking, currency, trade and transport, finance, geography, and a modern foreign language. Different classes of students will be expected to specialise in addition in subjects which have a particular interest for their calling. Bankers, for instance, would take world-history, with special reference to the nineteenth century; other students might take accounting, and so on. The B.Com. will necessitate three years' work, and one of the strong features of the course will be the attention paid to a modern language. The choice is undoubtedly ample, for, besides French and German, the list will include Polish, Czech, Rumanian, modern Greek, and the great Eastern languages. For the M.Com. two years' practical commercial experience will be required. The underlying idea here is to regard work in a merchant's office as equivalent to the practical work of the medical student in a hospital or of the engineering student in a workshop or factory.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, June 16.—M. Léon Guignard in the chair.—MM. A. **Lacroix** and **Tilho**: A geological sketch of Tibesti, Borkou, Erdi, and Ennedi. The sedimentary formations.—G. **Bigourdan**: Work of the Naval Observatory. Historical account of observations made between 1752 and 1796.—H. **Deslandres**: Remarks on the constitution of the atom and the properties of band spectra.—C. **Guichard**: Isothermal surfaces.—E. **Ariès**: The saturated vapour pressures and latent heats of evaporation of propyl acetate at various temperatures. From the equation of state developed in earlier communications, formulæ are deduced and applied to the calculation of the vapour pressures and latent heats of evaporation of propyl acetate; the figures are compared with the experimental results of S. Young with very satisfactory agreement.—M. E. Mathias was elected a correspondant in the section of general physics in succession to M. Georges Gouy, elected non-resident member.—E. **Kogbetliantz**: Trigonometrical series.—G. **Reboul**: The phenomena of luminescence accompanying the oxidation of potassium and sodium. This effect appears to be due to the formation and rupture of a skin of hydroxide; the presence of moisture is essential.—H. **Abraham** and E. **Bloch**: The maintenance of mechanical oscillations by means of lamps with three electrodes.—G. **Baume** and M. **Robert**: A glass manometer with elastic walls. The instrument described and figured consists of a thermometer with a bulb made with thin flat walls. This is surrounded

with a glass envelope containing the gas the pressure of which is to be measured. The apparatus can be utilised as a null instrument by connecting one side to an ordinary mercury manometer, or can be used directly after calibration. A set of measurements of the pressures of nitrogen peroxide at different temperatures is given as an example of the application of the manometer.—A. **Joannis**: Some properties of the acid phosphates. An account of the action of liquid anhydrous ammonia on the mono- and di-alkali phosphates.—J. **Guyot** and L. J. **Simon**: The action of dimethyl sulphate on the sulphates of the alkalis and alkaline earths. A mixture of methyl sulphate and potassium sulphate in equi-molecular proportions when heated to 200° C. reacts quantitatively to form potassium pyrosulphate and methyl ether. The action of sodium or lithium sulphate is similar, but the reaction is not complete.—Ch. **Audebeau Bey**: The lowering of the north of the Egyptian delta since the Roman Empire.—S. **Stefanescu**: The structure of the plates of the molars of *Elephas indicus*, and the different origin of the two species of living elephants. A study of the molars leads to the conclusion that the origin of *Elephas indicus* is quite different from that of *Elephas africanus*.—A. **Baldit**: Certain cases of diminution of the wind velocity with altitude.—M. **Mascré**: New remarks on the *rôle* of the nourishing layer of pollen.—S. **Posternak**: Two crystallised salts of the phospho-organic reserve principle of green plants. The two salts, details of preparation and purification of which are given, have the compositions $C_6H_{12}O_{27}P_6Ca_2Na_8$ and $C_6H_{12}O_{27}P_6Na_{12}$.—J. **Amar**: The hæmatopneic coefficient.—P. **Woog**: The variable persistence of luminous impressions on different regions of the retina.—A. **Robin**: The soluble and insoluble nitrogen in the tissue of cancerous liver; new conception of the genesis of cancer.—H. **Bierry**: Proteid sugar.—H. **Coutière**: The limb of the Arthropods.—E. **Sollaud**: The embryonic development of the Palæmonidæ.—P. C. **de Baillon**: The existence in locusts and crickets of an organ serving for the rupture of the chorion at the moment of eclosion.—M. **Baudouin**: Mode of ossification of the great trochanter in man of the polished Stone period.

BOOKS RECEIVED.

Text-book on Practical Astronomy. By Prof. G. L. Hosmer. Second edition. Pp. ix+205. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 9*s*. 6*d*. net.

The Preparation of Substances important in Agriculture. By Prof. C. A. Peters. Third edition. Pp. vii+81. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s*. net.

Australia: Problems and Prospects. By the Hon. Sir Charles G. Wade. Pp. 111. (Oxford: At the Clarendon Press.) 4*s*. net.

Vicious Circles in Disease. By Dr. J. B. Hurry. Third and enlarged edition. Pp. xx+377. (London: J. and A. Churchill.) 15*s*. net.

The Nile Projects. By Sir William Willcocks. Pp. xvi+184+plates 6. (London: E. and F. N. Spon, Ltd.)

DIARY OF SOCIETIES.

MONDAY, JULY 14.

FARADAY SOCIETY, at 8.—L. A. Wild: A Method of Measuring the Magnetic Hardness of Ferrous Metals and its Utility for carrying out Research Work on Thermal Treatment.—K. Honda and H. Takagi: A Theory of Invar.—W. E. Forsythe: The Disappearing Filament Type of Optical Pyrometer.—Dr. A. W. Porter: The Equation for the Chemical Equilibrium of Homogeneous Mixtures. I. Equilibrium at Constant Temperature.—F. H. Jefferey: The Electrolysis of Solutions of Sodium Nitrate using a Silver Anode.—I. Langmuir: The Mechanism of the Surface Phenomena of Flotation.—E. A. Ashcroft: Some Chemically Reactive Alloys.

TUESDAY, JULY 15.

SOCIETY OF CHEMICAL INDUSTRY (at the Mansion House), at 11 a.m.—Annual General Meeting. Address by the President, Prof. Henry Louis. —At 3.30 p.m.—Conference. Sir William J. Pope: Inter-Allied Chemical Federation.—Prof. C. Moureu: "Sir William Ramsay."

WEDNESDAY, JULY 16.

SOCIETY OF CHEMICAL INDUSTRY (at the Clothworkers Hall, Mincing Lane, E.C.), at 10.30 a.m.–1 p.m., and 3–5 p.m.—Conference on the Production and Consumption of Sugar within the British Empire. *Speakers*: Major Courthope, Sir Richard Garton, Sir Daniel Hall, W. Martineau, Dr. E. J. Russell, Sir George Sutherland, and Louis Souchen.—At the Salters' Hall, St. Swithin's Lane, E.C., at 10.30 a.m.–1 p.m., and 3–5 p.m.—Conference on Power Plant in Chemical Works. Capt. C. J. Goodwin: Waste Heat Boilers and Pulverised Fuel in Chemical Factories. —A. H. Lymn: Modern Gas Producer Practice for Power Purposes.—J. L. Hodgson: Differential Pressure Meters for Measuring Gas, Steam, and Air Flow.—Prof. W. A. Bone and P. St. G. Kirke: Recent Developments in Surface Combustion Boilers.—P. Parrish: A Modern Chemical Works Power Plant and the Production of Steam from Low Grade Fuel. —Prof. J. W. Hinchley: Notes on the Operation of a Chemical Works Power Plant.—H. Martin: Electrical Supply in a Chemical Works.

THURSDAY, JULY 17.

SOCIETY OF CHEMICAL INDUSTRY (at the Salters' Hall, St. Swithin's Lane, E.C.), at 10.30 a.m.–1 p.m., and 3–5 p.m.—Conference on Dye Stuffs, Synthetic Drugs, and Associated Products. Dr. Herbert Levinstein: Progress in the British Dyestuff Industry.—James Morton: Dyestuffs and British Textiles.—Prof. G. T. Morgan: Certain Colour-producing Intermediates.—E. V. Evans: The Manufacture of Intermediates.—F. H. Carr: The Manufacture of Synthetic Drugs.—Dr. W. R. Innes: Photographic Chemicals.—Dr. M. O. Forster: The Organised Preparation of Laboratory Chemicals.—At the Goldsmiths' Hall, Foster Lane, E.C., at 10.30 a.m.–1 p.m.—Conference on the Chrome Tanning Industry. Prof. D. McCandlish: The Development of the Chrome Tanning Industry in the United States of America.—M. C. Lamb: The Progress of the Chrome Tanning Industry in Great Britain.—Dr. Gordon Parker: The War Services of the Chrome Tanning Industry.—At 3–5 p.m.—Conference on Recent Developments in the Fermentation Industries. Sir Frederick Nathan: The Manufacture of Acetone.—Amos Gill: The Acetone Fermentation Process and its Technical Applications.—A. Chaston Chapman: The Employment of Micro-organisms in the Service of Chemical Industry—A Plea for a National Institute of Micro-biology.

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THURSDAY, JULY 17, 1919.

THE FIGURE OF THE EARTH.

The Earth's Axes and Triangulation. By J. de Graaff Hunter. (Survey of India Professional Paper, No. 16.) Pp. viii+219+vi charts. (Published by order of the Government of India. Dehra Dun: Printed at the Office of the Trigonometrical Survey, 1918.) Price 4 rupees or 5*s.* 4*d.*

THE Survey Department of India has long been labouring under a disadvantage which attaches to pioneers in that the fundamental constants employed as the bases of its computations, and upon the accuracy of which its final results depend, are now, and have been for a long time past, known to be in substantial error. The axes of the earth hitherto used are those derived from Everest's early work, and in view of the enormous amount of geodetic data accumulated since they were formulated, their values naturally require considerable correction in order to fit in with more recent knowledge. Furthermore, owing to the magnitude of the local attraction at Kalianpur, the point taken as the origin of the coordinates of the survey, the absolute position of this origin, and hence of every other point deduced from it, requires a further correction on this account. This correction in the case of longitudes is a constant quantity of the same magnitude at every point, and in the case of latitudes a varying quantity, depending, first, upon the absolute change in the assumed latitude of the origin, and, secondly, upon the changed distance between origin and point due to the changed spheroid.

To recompute the whole triangulation with the new origin and new axes would have been a piece of numerical work of altogether prohibitive magnitude, and the primary object of Mr. Hunter's research was to derive a formula for ascertaining the necessary corrections without repeating the whole calculation. This is not quite such an elementary problem as it appears. It might possibly be thought that it would be easy to compute the correction at a number of symmetrically situated points, say the intersections of each degree of latitude and longitude, and thence to derive the correction at any other point by interpolation. This, however, cannot be done in any simple and direct way. To derive the proper value of the correction, the "route" along which the position of the point was determined has to be considered, and if, for example, assuming the position of the origin as 0°, 0°, we thence determine the correction at the point 1°, 1°, the value will be different according as we proceed along the parallel from 0°, 0°, to 0°, 1°, and thence along the meridian to 1°, 1°, or conversely along the meridian to 1°, 0°, and thence along the parallel to 1°, 1°. This discrepancy arises from the fact that the original observations were "adjusted"—*i.e.* constrained to fit a particular spheroid—and will consequently not fit a different spheroid without distortion. There must therefore always remain a degree of uncertainty in the computed corrections, and in the final results it is claimed by Mr. Hunter, apparently with full justification, that these residual errors are of magnitudes such as to be negligible in the most precise geodetic survey.

The whole question of the adjustment of the errors of a triangulation is fully discussed, and a new method of considerable practical importance set forth. The volume embodies the results of a most laborious research, and reflects great credit upon the author and upon the Survey of India. A perusal of it brings home, however, with great force a question much to the fore lately upon which a definite solution appears at length to be in sight, viz. the imperative necessity of establishing a geodetic institute in this country. Many of the problems opened up in this volume are applicable to geodetic surveys wherever they may be undertaken, and it is scarcely an ideal state of affairs that the great responsibility for laying down new methods, and for all practical purposes deciding upon their validity, should rest on the shoulders of one survey department, often, moreover, on those of one man. These general questions should be fully investigated by all concerned who are in a position to help, and an institute which will co-ordinate the higher survey work of the whole British Empire will be in a position to assist individual survey departments in all questions of general and fundamental importance to the science of geodesy.

E. H. H.

PLANT PHYSIOLOGY.

Life Movements in Plants. By Sir J. C. Bose. (Transactions of the Bose Research Institute, Calcutta. Vol. i., parts 1 and 2, 1918.) Pp. xxiv+251+xv. (Calcutta: Bengal Government Press, 1918. Published by the Bose Research Institute, Calcutta.)

IN addition to a series of scientific papers, the volume before us contains administrative details of the Research Institute and an inaugural address delivered by Sir J. C. Bose on November 30, 1917, when the institute was opened.

India is to be congratulated upon the foundation and generous endowment of an institute of this character, which is intended to include departments for physics, plant physiology, animal physiology, and psycho-physics, as well as their applications to agriculture and medicine.

The address outlines the events leading up to the organisation of the institute. It is pointed out that the two ideals before the country are complementary and not antagonistic. "There is first the individualistic ideal of winning success in all affairs, of securing material efficiency and of satisfaction of personal ambition. These are necessary, but by themselves cannot secure the life of a nation. . . . The weakling who has refused the conflict, having acquired nothing, has nothing

to renounce. He alone who has striven and won can enrich the world by giving away the fruits of his victorious experience. . . . The ideal of giving, of enriching—in fine, of self-renunciation in response to the highest call of humanity, is the other and complementary ideal."

The scientific papers are divided into two groups: part i., "Response in Plant Organs," and part ii., "Growth and its Responsive Variations." In many of the papers Sir J. C. Bose was assisted by his research students.

Ever since the days of his clumsy efforts to induce preparations of frogs' nerves and muscles to perform their movements with military precision, the present writer must confess to a dislike to all dealings with smoked glass plates and tracings thereupon. The records upon which the conclusions of the Calcutta laboratory are based are, however, on an entirely different level. In these, skill in manipulation and the most ingenious clockwork and electrical devices have been combined to evolve methods whereby the minute movements of response to carefully regulated stimuli have been recorded on the same chart as their time relations.

In order to cut out errors arising from the variation of factors other than the one under consideration, the observations are in most cases made only for a very short period of time. This is possible with the aid of the great magnification employed; the latter is obtained by a combination of levers coupled with the disturbance of equilibrium in a magnetic field due to the motion of the steel lever in it.

The massed attack of the workers in the Bose Institute has in a very short time cleared up much that was obscure in the phenomena of response. It may be noted, however, that the papers contain very few references to current literature, but this is perhaps owing to the novelty of the methods used. In particular, the recent work upon the transmission of a stimulus through a glass tube in the absence of all protoplasmic connection is of interest in relation to certain of the Calcutta experiments.

W. R. G. A.

ABNORMAL PSYCHOLOGY AND EDUCATION.

Echo Personalities: A Short Study of the Contributions of Abnormal Psychology towards the Solution of some of the Problems of Normal Education. By Frank Watts. Pp. 111. (London: George Allen and Unwin, Ltd., 1918.) Price 4*s*. 6*d*. net.

MANY readers of the voluminous literature upon mental and nervous disorders published almost weekly in our own country must have been struck by the vast stores of information for the educationist which these writings contain. The significance for education of much of this information lies chiefly in the fact that it tells the teacher what to avoid, but an almost equal amount is grist of the finest quality for his own particular mill; for many of the painstaking and minute analyses of these states of mental twistedness are but the prelude to a subsequent process of re-education. Here, if anywhere, may the educator of the normal child help and find help.

While, as we said, many persons must have felt all this, few have ventured upon the task so courageously undertaken by Mr. Frank Watts, that of refracting the rays of light from the dense and clouded medium of psychopathology into the somewhat clearer atmosphere of normal education. And if one feels, here and there, that an important ray fails to get through, there is little justification for grumbling at the properties of our prism, for it is almost the only one we have.

Mr. Watts has read widely; he leads us from the early giants of rational mental treatment, Pinel and Esquirol in France, and Conolly in England, to our contemporaries—whose height we cannot yet measure, perhaps because they stand too close to us—Janet of Paris, Freud of Vienna, and Jung of Zürich. In his chapter on "Psychopathology and Personality," which seems to us the best in the book, he gives clear little sketches of the typical "nervous" disorders, never forgetting that the blessed word "abnormal" does not exempt him from the obligation of showing their near relationship to "normal" eccentricities and weaknesses.

In his chapter on "The Crowd at School" he boldly acknowledges the existence of a fact—often protectively coloured, but nevertheless angular and unyielding when one strikes against it—that suggestion is the means by which most of the child's beliefs are inculcated. He draws from this the obvious conclusion that the teacher's duty is to understand the mechanism of suggestion and thereby to utilise its advantages and avoid its pitfalls. It is good to see Mr. Watts making use of that salutarily disquieting book by Mr. Trotter, "The Herd Instinct in Peace and War." But we feel that a still more extensive use of Mr. Trotter's explanation of the present unfashionableness of rational opinion and of his suggestions for making it fashionable in the future might have strengthened this chapter still more. Perhaps, however, the trouble about Mr. Trotter's "Herd Instinct" is that the title would be improved if he avoided the term "instinct" and used another word instead of "herd." Which brings up the subject of Mr. Watts's own title. On buying the book, one may understand what the title means. But is not this a reversal of the usual process?

The final chapter, on "The Psychology of the Defective Mind: its Influence upon Teaching Methods," deals in a very up-to-date way with the subject. One paragraph may be offered to the reader here as food for thought:

"One may perhaps draw attention here, in passing, to the popular modern educational ideal of self-realisation as the ultimate good. Séguin occupied himself, like Froebel and Rousseau before him, wholly with the problem of the perfecting of human personality, but a sane study of abnormal psychology should prevent us adopting the unfortunate heresy that personality is the most

sacred of all the good things with which the universe teems."

In his book Mr. Watts has probably attempted too much. But ample justification for this is his readiness to share his knowledge with others.

T. H. P.

OUR BOOKSHELF.

The Human Skeleton: An Interpretation. By Prof. H. E. Walter. Pp. xv+214. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 10s. net.

THE human skeleton has been the favourite text of anatomists for many a day, but never before has an author couched his discourse in more racy and picturesque phraseology than that employed by Prof. Eugene Walter. Indeed, it is the author's method of treatment which justifies his book, for the theories and opinions which he sets forth are those with which medical students have been familiar for a past generation. The book is designed to appeal to the layman rather than to the professional student. "The ordinary layman seems, subconsciously at least, to regard a consideration of his 'insides' as something rather impertinent and indelicate, a subject, in truth, unavoidable whenever complications set in, but quite barren and forbidding to one simply in quest of pleasant stimulating intellectual adventures." Prof. Walter's aim is to represent the human skeleton as "a very wonderful and animated piece of architecture, full of beauty and inspiration for one who looks upon it with a seeing eye and considers its age-long evolution with a comprehending and sympathetic mind."

To elucidate the subject of his discourse the author culls facts from the whole realm of the animal kingdom, both present and past, and cites examples from standard works on embryology and anthropology. A living internal skeleton, such as vertebrate animals are provided with, represented "a brand-new idea of far-reaching evolutionary significance," whereby "*Thermomorphs* lifted tons of flesh into the air upon majestic bony scaffoldings." Hair and epidermal structures are described as "relics of a bygone age." The human skeleton illustrates the "thrift and resourcefulness of Nature," the "chequered career" of individual structures, and, in many of its parts, "a complicated series of makeshifts." Here and there, however, one observes that the author's statements are loose and scarcely accurate. His statement on p. 74 that "the odontoid process rocks back and forth and from side to side upon an articular surface within the ring of the atlas, thereby allowing lateral movements of the head," is one which would prove fatal to a candidate in an examination in elementary anatomy, and unfortunately there is a considerable number of similar misstatements of fact. One regrets that the author has not taken more trouble to become accurately acquainted with the human skeleton, for he possesses a very happy power of exposition.

Manual de Fabricantes de Azucar de Caña y Quimicos Azucareros. By Dr. Guilford L. Spencer. Traducción Autorizada de la 6ª Edición Inglesa. By Dr. Gaston Alonso Cuadrado. Pp. xvii+617. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 23s. net.

DR. SPENCER'S "Handbook for Sugar Manufacturers and their Chemists" is well and favourably known to sugar technologists. In the sixth edition, of which the volume under notice is the authorised Spanish translation, the principal new feature is a chapter on evaporation, written by Prof. W. H. P. Creighton, of Tulane University, New Orleans. In this the scientific principles which govern the concentration of sugar juice by heat are elucidated at some length, and their practical applications to vacuum evaporation explained.

Speaking generally, the section devoted to manufacturing processes gives a good account of sugar production as carried out according to the best American practice in Louisiana and Cuba. In the earlier part, dealing with crude sugar, descriptions of various modern improvements are included, such as the "Norit" carbon process of decolorising, the use of Hind-Renton grooved rollers in the mill, and the Bach "sulphitation" process as employed in Java. Mr. G. P. Meade, superintendent of a Cuban sugar refinery, contributes an interesting chapter on refining. The analysis of sugars and the general chemical control of the manufacture are fully explained, a good collection of tabulated data being provided.

Like the original English work, the translation is in a handy, compact form, suitable for carrying in the pocket. Its six hundred pages will be found close-packed with sound and well-arranged information.

Prothèse Fonctionnelle des Blessés de Guerre. Troubles Physiologiques et Appareillage. By Dr. Ducroquet. Pp. xi+235. (Paris: Masson et Cie, 1919.) Price 5 francs.

THE equipment of soldiers who have been permanently lamed or maimed with appliances which will mask or make good their defects tasks to the utmost that department of surgical endeavour known as prosthesis. Dr. Ducroquet's "Functional Prosthesis" is entirely concerned with defects and injuries of the arm and leg, and hence the problems he has to solve are those relating to the kind and degree of movements which occur at the various joints of the limb. A very clear and accurate account is given of the mechanism of walking and of the manner in which defects can be made good by the use of appliances. Both surgeon and anatomist will find much that is new in Dr. Ducroquet's pages, particularly regarding the position and direction of the axes of the various joints of the limbs. This book has a value which extends beyond the immediate needs of the military surgeon.

A. K.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Electro-Atomic Phenomena in the Magnetic Field.

I HOPE you will grant me the opportunity of making some brief observations on an article which appeared in the issue of NATURE for April 3, in which the anonymous reviewer "N. R. C." delivers a judgment of exceptional severity on one of my publications, "Electro-atomic Phenomena under the Action of the Magnetic Field," and for that reason very different from the other judgments which have come to my notice.

I shall limit myself to a few points with the aim, not of inducing the reviewer to change his opinion, but of facilitating somewhat an equitable estimate by readers of NATURE, which is so widely diffused and read by so many cultivated persons who are not occupied in any particular way with physics.

The reviewer seems unwilling to take into consideration the fact that my book was written with the sole purpose of bringing together and co-ordinating my recent very numerous new experiments, of not one of which (and this seems to me something important) has he been able to place the perfect validity in doubt. Hence he has confined himself to attacking the hypotheses proposed by me to account for the new facts. He declares that he is occupied only with the theory put forward to explain the facilitated ionisation by shock which I have demonstrated to take place through the influence of the magnetic field. He says, in fact: "This matter has been discussed less thoroughly than the theory of magnetic rays." By this he evidently intends to convey to the reader the conviction that the latter theory has been destroyed by the courteous objections of some physicists, to whom I believe I opposed exhaustive, and not less courteous, rectifications.

The theory under examination at present consists in this: Under the action of the field a gaseous molecule tends to orient itself in such a manner that the force due to the field, and acting upon a satellite electron, acts towards the outside of the atom, and therefore facilitates the liberation by shock of the electron itself. If the atom has one single satellite electron, certainly it will act in this manner, because it will be paramagnetic according to the accepted theory. And the behaviour of the air, which was the gas experimented upon by me, is paramagnetic.

Hence no one can succeed in understanding what the question propounded by the reviewer means: "How Prof. Righi arrives at a result so directly contrary (?) to that on which Langevin's theory of diamagnetism is based? According to the new theory, all atoms must be paramagnetic." As if I had declared that I had obtained my results by experimenting, not only on air, but also on diamagnetic gases, it being granted that for the latter that objection would have a serious value. It is well to direct attention to the fact that the reviewer seems to believe that a diamagnetic substance orientates itself, and in a sense opposite to a paramagnetic, in a *uniform* field.

It is a method of polemic unhappily sometimes adopted (although rarely in scientific questions), this of combating assertions which were not made; unfortunately, such a method can leave an unfavourable, although unjust, impression on the great majority of readers.

Furthermore, if (and this is not at present the case) there should some day be presented any facts contravening the theory of Langevin, it need not be necessary to choose between this and another theory; so long the nature of the connections, in virtue of which the tendency of the trajectory of an electron to orient itself in a given manner influences the orientation of the entire atom, remain still indeterminate.

I refrain from noticing the final hint on the typographical quality of my book. It is not clear whether this constitutes an unjust estimate of the sacrifices undergone by my country during the recent war—in which case I should protest with all my soul—or whether it is nothing but a witticism in somewhat questionable taste, intended to raise a contrast between the external aspect of the book and its contents—in which case I would leave the judgment to readers of NATURE.

AUGUSTO RIGHI.

Bologna (Italy), April, 1919.

I AM certainly sorry that Prof. Righi should regard my review as of "exceptional severity." It is true, of course, that more space is occupied in it by criticism than by the expression of approval; but this is simply due to the fact, familiar to every reviewer, that while the good features of a work can often be described in a single sentence, many sentences are usually necessary to explain why a less favourable view is taken of other features. It was not my intention to imply that the book is without value, and I cannot help thinking that Prof. Righi has—unintentionally, of course—adopted the practice which he deprecates of "combating assertions which were not made."

I am not at all "unwilling to take into consideration the fact that the book was written with the purpose of co-ordinating very numerous new experiments." I stated, and I repeat, that Prof. Righi "has recorded a large number of interesting and suggestive facts, which deserve the close attention of all students of physics." What more could I say, unless I proceeded to give an account of these facts—a task which is entirely unnecessary and obviously impossible in any reasonable space? Again, when I said that "this matter has been discussed less thoroughly . . ." I "intended to convey" nothing but a bare statement of fact which provided a reason for the choice of one portion of the work rather than another for more detailed discussion. So far as I can ascertain by an examination of the literature, there are much fewer papers dealing with Prof. Righi's theory of magneto-ionisation than with his theory of magnetic rays. If I have overlooked some of the literature, I apologise; but if I have not, it is not my fault that one of the theories has received more attention than another.

No useful purpose would be served by a further elaboration of my criticism of Prof. Righi's theory. A reviewer is surely not only entitled, but in duty bound, to record his difference of opinion from the author on any matter which is essential to the work reviewed; in doing so he does not condemn the author, but merely invites those interested in the matter to read the work and to judge between the conflicting opinions. Prof. Righi has expressed his opinion in his book, and I have indicated mine very briefly in my review; if there is to be further discussion, it had better take place in the normal manner in technical journals.

But perhaps I may add a few words in further explanation of my reference to Prof. Langevin's theory. According to that theory, when a revolving electron is introduced into a magnetic field, the radius of the orbit is unchanged, but the angular velocity is

altered in such a manner that the change in magnetic field due to the electron is opposed in direction to the magnetic field in which it is placed. The orbit thus behaves like a diamagnetic body, and on this fact is based Prof. Langevin's theory of the fact that in weak fields most bodies are diamagnetic. On the other hand, if I understand rightly, according to Prof. Righi the effect of introducing the orbit into the magnetic field is to change the radius, but not the angular velocity, and in such a manner that the change in the field due to the orbit is in the same direction as that of the field in which it is placed. The orbit behaves like a paramagnetic body, and it would seem to follow that all bodies should be paramagnetic. The two views are irreconcilable, and—again unless I have misunderstood Prof. Righi—either he or Prof. Langevin must be wrong. I suggested that if he thinks Prof. Langevin is wrong, he should have explained why he thinks so; or if he thinks his view is not inconsistent with that of Prof. Langevin, he should have told us how he removes the apparent inconsistency.

In self-defence, perhaps I may add that I do not think that a diamagnetic body orientates itself in a uniform field, and that I never suggested in any way that I thought so.

I must refrain (in the same manner as Prof. Righi) from noticing his last paragraph. I cannot imagine why he should read into my words such implications. I meant nothing but that the style of the book was admirable, that it was very refreshing to see a well-produced book once more, but that, in my opinion, the excellence of the production did not compensate for the absence of an index.

And as for my anonymity, I venture to believe that most English physicists would identify me from my initials; at any rate, they would recognise that the writer was not one of the small and distinguished band who could claim scientific precedence of Prof. Righi. But in order that any doubts as to my competence or incompetence may be removed, I beg leave now to sign myself NORMAN R. CAMPBELL.

Kettlewell, May 1919.

The Collection and Presentation of Public Statistics.

IT is a matter of common knowledge to all who have had occasion to use official statistics, whether published or Departmental, that the national and Imperial equipment for obtaining and publishing statistical data is very imperfect in its scope and inadequate in its machinery.

Further, the efforts made are Departmental, are under no common controlling or directing authority, and suffer very gravely from lack of co-ordination.

There is no need to adduce proofs of these statements, or to enumerate the various efforts, fruitless in the main, which have hitherto been made to remedy these defects.

The council of the Royal Statistical Society has appointed a special committee to deal with the subject in the belief that the time is now ripe for a new movement in the direction of reform, and that the consciousness of the existing defects is present to the minds of his Majesty's Ministers, Members of Parliament, and Civil Servants, as well as to others interested in statistics.

It is proposed to petition his Majesty's Government to set up a Parliamentary Committee to examine the whole question of the collection and presentation of public statistics, and to report on means of improvement. It is believed that this method of procedure is more likely to be effective than the pressing of specific proposals on his Majesty's Ministers.

The officers of the local government and other public bodies, as well as of scientific societies, are being invited to bring the matter at once before their councils. Moreover, publicists and others who are known to be interested are being approached directly.

We ask the courtesy of your columns to lend support to this movement, and we invite your readers to help with their influence and signatures. The council will be glad if all who are disposed to sign such a petition would communicate with the Secretary, Official Statistics Committee, Royal Statistical Society, 9 Adelphi Terrace, W.C.2. A copy of the petition will then in due course be sent to them for signature.

GEOFFREY DRAGE,
Chairman, Official Statistics Committee.

Royal Statistical Society, 9 Adelphi Terrace, Strand, London, W.C.2, July 10.

THE FISHERIES AND SCIENTIFIC RESEARCH.

THERE has been quite unexpected confusion of counsel with regard to post-war reorganisation of the fishing industry. The collapse of the German submarine campaign about the middle of last year left everyone grateful to the fishermen and wondering what ought to be done for them in the future. That feeling "created an atmosphere," and a number of inquiries began. First of all, the English trawler owners anticipated the end of hostilities, and had a scheme of reconstruction ready by the time the Armistice had been granted. This attracted the attention of Lord Ernle, but did not succeed in impressing the War Cabinet (who had by then "other fish to fry"). The Scottish Steam Drifters' Association was equally ready with its scheme, and about the same time appeared the report of the Haldane Committee on the Machinery of Government, with its proposals for the creation of a State Department of Research, which was to take account of fisheries. Next came an inquiry by a committee of the British Science Guild, and then the deliberations of the National Sea Fisheries Protection Association (which are still going on). The subcommittees of the association began to prepare proposals for scientific research, education, and codification of the law. Following that, the Development Commissioners appointed a committee to advise them as to the best way in which research could be promoted. As if all this were not enough, the International Research Council has now arranged to meet in Brussels on July 18, and it is expected that interesting matters with relation to the exploration and fisheries of northern seas will be discussed.

Meanwhile, the conditions are very much what were anticipated in the memorandum presented to Lord Ernle last year. Fish is scarce and dear in the retail shops, and abundant and cheap at the ports of landing, for the means of transport have largely broken down. Exporting has become difficult even with Government guarantees. There is no scientific research yet, and no simplification of the administrative procedure. Nothing has been done for the fishermen, the Admiralty scheme

of co-partnery in the vessels built as patrols during the war having been opposed by the trawler owners because of its financial unsoundness. The vessels themselves are now offered for public sale. The situation obsesses anyone who has anything to do with it, and has become intolerable—if not farcical.

It is to be hoped that the confusion is only the means towards some satisfactory solution of the difficulties, that the time will come when everybody will be thinking alike—a psychological moment, as the phrase goes—and that then the problem will resolve itself. Anything that is published at the present time is interesting in view of this consummation, and several utterances of late seem to help a little. The report of the Executive Committee of the British Science Guild presented to the general meeting on June 17 last, Prof. Herdman's report to the Lancashire Fisheries Committee, recently issued, and a lecture by Prof. McIntosh, published in the columns of NATURE of July 3 and 10, all have interest in this connection. The guild's report will be received with general approval by men of science, though it may offend the Philistines in Government offices and in the industry. It agrees with the recommendations of the Machinery of Government Committee, regards thought and investigation as desirable preliminaries to action, and urges that the organisation of scientific and industrial research should be the task of a State Department presided over by a Minister. Investigations controlled by administrative officials, the report suggests, are likely to be narrowed in scope and abandoned if they should not prove to be "practical." Probably this is true, but one seems to notice that fishery administration is becoming less important than it was, while scientific and industrial research is much more so, and is attracting a greater share of public attention. Development can be helped very much by investigation, but is only likely to be hampered by restrictions and regulations (which have been the motives of the "administration" of the past). Governmental and other fishery authorities are, therefore, unlikely to neglect scientific and industrial research in the future.

Probably both the administrative people and the researchers will approve of Prof. Herdman's summary of the situation. There are, he says, two categories of fishery research, one having practical administrative, and the other speculative, value. And yet there are not two categories, but only one, for the same mechanism of research can, and does, achieve both kinds of results. Practical results raise questions of strictly scientific interest, while speculative results may at any moment become of practical importance. So also there might be two ways of controlling and organising research, one by a Department of State, which might only think and suggest, and the other by the administrative authorities making the universities their instruments. To deprive the authorities of the privilege of doing research would tend to sterilise their activities, while to create a Government Department quite out of touch with the industry would tend to set up a kind of Olympic pedantry. So these two means of controlling research must also be one. In short, Prof. Herdman adopts the methods of Athanasius, and in seeking to reconcile the intransigents suggests a way out from the confusion.

Lastly, Prof. McIntosh, after a long life spent in marine biological research and a greater experience of fishery investigation than anyone else, seeks to summarise his views as to what has been achieved by the International Council for Fishery Investigations during the last dozen years or so. That research was instigated, on one hand, by the "melancholy anticipations of the pessimists," and, on the other, by the far sounder motive of seeking to discover the reasons for seasonal physical and metabolic changes in the ocean and in its inhabitants. Pessimism as to the future of the fisheries was well expressed by Prof. Garstang in his paper on "The Impoverishment of the Sea," and a vigorous optimism was proclaimed by the *doyen* of marine biologists in his book "The Resources of the Sea." There were thus two opposed theses, one that the exploitation of the fishing-grounds was exceeding their recuperative power, and the other that fishing operations were carried on on too small a scale to make any appreciable difference. Now nobody is *quite* sure which thesis is proved, and anybody who is asked to give an opinion will certainly be inclined to hedge.

This back-number controversy, of which Profs. McIntosh and Garstang were the protagonists, has not so much interest for us just now. Some time must elapse before fishery operations will attain, much less surpass, their pre-war intensity; it will be a long time before the transport systems of Europe will be able to take fish everywhere that it is required, and so long as the prices of inferior categories of fish remain high not so much complaint of impoverishment of the superior categories will be heard from the *entrepreneurs*. But it is certain again to arise, and as we ought to possess the means of closuring it we cannot afford to scrap the mechanism of international investigation or kill the germ of international regulation. Even if it should be proved that the cherished fear of progressive impoverishment is a real one, *that* would be a result of exceedingly practical importance, for we might then be enabled to scrap the machinery of regulations, restrictions, prohibitions, and policing, all of which is expensive to maintain, and intolerable if it is unnecessary. But even then there would arise questions as to means of rendering this superabundance of food available on a greater scale by developing methods of preservation and utilisation in ways not yet attempted. And since man does not live by food alone, an international organisation will have much to do in the promotion of purely oceanographical discovery, which may be regarded as quite properly a part of the activities of civilised communities. J. J.

AN UNDEVELOPED ASPECT OF ENGINEERING TRAINING.

A SURVEY of the careers of students who enter the engineering profession after a technical training at a university reveals the fact that in very many cases the student, within a comparatively short time of his leaving the university, finds himself in need of knowledge which his training has neither provided nor even suggested would in time be required. This fact was emphasised in a paper recently presented to the Institution of Electrical Engineers by Lt.-Col. W. A. J. O'Meara, who urged the inclusion in the training of engineers of courses of instruction relating to non-technical subjects, such as book-keeping, custodianship, administration, law, etc. Further emphasis is given to this point of view by the considerable amount of published matter relating to various aspects of management in connection with industrial affairs, with much of which the engineer is nowadays directly concerned.

In most of the British universities having faculties of engineering, technical studies represent the outstanding feature of instruction, and it must be admitted that such studies will always be the real backbone of an engineer's training. At the same time, with changing industrial conditions, technical instruction alone—presupposing that this will be followed by a period of practical training—is not an adequate preliminary equipment for an engineer. Consider, for instance, a student who enters a manufacturing branch of the engineering industry—a branch which offers the widest scope and attracts probably the greatest numbers of technically trained men. Such a student will, after his works training, find that his natural interests lie in the direction either of the commercial, technical, works administration, or research department of the organisation. In any one of these departments it is of fundamental importance that he should have a thoroughly sound grasp of the principles of industrial economics, since a cardinal feature of all manufacturing effort is to produce economically, and this is not possible if the basis on which costs are computed and compared is not fully understood. An engineer will be a better designer, for instance, if he can discuss intelligently with the works management details of manufacturing cost. Similar ability is of value to the commercial engineer, and will enable him to appraise correctly the strong and weak features of competitors' efforts. Such knowledge is not at present available in most of the courses of instruction for engineers, although many universities and colleges are paying attention to the matter. In some large works this instruction is given to members of the staff, including the technically trained apprentices, who can make best use of the knowledge, but it is important that works costing and accounting should occupy a much more definite position in the regular instruction of the engineer.

In view of the already overcrowded courses, the main principles underlying these studies could be taught to the student before he enters the university, and he might receive instruction in their practical application, either in post-graduate courses in the university, or by systematic instruction in the works into which he ultimately proceeds.

Another most important subject is that broadly covered by the term "industrial administration," comprising modern methods of management. Shortened hours and increased wages, together with the burdens of taxation imposed by war, emphasise the necessity for increased and more efficient production, and bring to the fore the importance of the prevention of waste, whether relating to time, effort, or materials; a study of the periods of working that will result in optimum effort; factory conditions as regards lighting, ventilation, the supply of food, and everything that conserves the health and vitality of the workers; the selection of workers so that the job is adapted to their characteristics rather than that they should be forced to adapt themselves to fixed conditions imposed by the character of their work; and means for improving the collective efficiency of workers and management by ensuring harmonious relations between them. Related to this subject is the all-important one of the education of both the juvenile and the adult worker, the former being particularly pressing in view of the new Education Act.

We should like to see the principles of industrial administration laid down in the university courses in so far as this can be done without jeopardising the value of the present curriculum. In this connection it is interesting to note that at the Municipal College of Technology, Manchester, a directorship in industrial administration has been set up, which not only provides public lectures to which managers and others interested in industry are invited, but also affords a full-time course of instruction to young men who desire to prepare themselves for managerial positions in industry.

RECONSTRUCTION PROBLEMS.

THE Ministry of Reconstruction is issuing a series of pamphlets which deserves to be very widely read by the public, as they bring briefly and yet clearly to notice a number of considerations of great importance, though probably not familiar to everyone. Two of these pamphlets bear the titles "The Classics in British Education" (No. 21) and "Natural Science in British Education" (No. 26).

It is remarkable, notwithstanding the discussions which have been going on during the last forty years or more on the conflict between literature and science in education, how much confusion still exists, even in the minds of fairly well informed people, as to the aims of the two parties in the controversy. It is a misfortune that the word "science" has become perverted from its original meaning to such an extent that it now

seems to connote something mysterious and apart from ordinary modes of thought or practice, whilst, as Huxley pointed out long ago, science is just common-knowledge, but exact and purified from error whether in observation or inference. In the words of the pamphlet, science should be "treated as one of the humanities or a record of the progress of human thought applied to the solutions of the problems of Nature."

Sir Joseph Thomson's Committee, the report of which is largely the theme of this publication, states: "We are by no means sure that the popular interest in science is as great to-day as it was thirty years ago." This is a point which might well be regarded as debatable, in view of the constant talk about the marvels of modern scientific discovery and invention, but that ignorance still prevails in unexpected quarters is quite true. It seems necessary that the education of those especially who are likely to become members of the ruling class should be so far rectified that in the next generation it can no longer be said that the Ministry of the Crown is from top to bottom ignorant of the most rudimentary ideas in this direction.

As concerns the subject of the other pamphlet under notice, there is much here that deserves careful thought. We may agree that "the real enemy of education is want of faith in its value," and deplore the general tendency to look for purely utilitarian results. We may agree that "if there is one thing more certain than another it is that the Allies won the war because their moral ideals were higher than those of Germany," while we may demur to the assumption that these arise to any preponderant extent out of the study of the Greek and Latin classics.

The pamphlet is composed in a laudable spirit of liberality towards other studies, and it is well that each side should remember that "one mind responds best to one stimulus and one to another," but it remains clear that a mind nourished on purely literary material, while careless of the physical universe, is not only deprived of one great source of delight, but is also incapable of perceiving many of the influences which are at work in shaping human destinies.

THE RETURN OF R 34.

THE rigid airship R 34 has successfully accomplished the return flight from New York to Pulham, in Norfolk, where it landed safely on July 13, having left Long Island on July 10. As might have been expected from the direction of the prevailing winds, the return journey was made in considerably less time than the outward crossing, occupying only 75 hours, as against 108 for the previous flight. The highest speed recorded on the return crossing was 72 knots, or nearly 83 miles per hour. One of the engines broke down completely in mid-Atlantic, but this did not seriously hamper the airship, the full power of which was only used when severe head-winds were encountered. Major Scott's account of the voyage seems to indicate that thick fogs are the airship's worst enemy, preventing, as they do, the observations which are required to determine the course. A dead reckoning by compass and air-speed indicator is still possible in a fog, but this only gives the course relatively to the air, and takes no account of the motion of the air relatively to the earth.

The start homeward was hurriedly arranged to prevent the airship being caught in a gale at her moorings, and the strong westerly wind which was blowing at the time enabled R 34 to make rapid headway on her course eastwards. Weather conditions on the homeward passage were very similar to those prevailing over the Atlantic during the outward voyage, but the more southerly route followed on the western side of the ocean led to the avoidance of much bad weather. Anticyclonic conditions have prevailed over the open Atlantic for some time past, but a change may reasonably be expected soon. After the summer weather conditions have broken up, Atlantic flight by any class of machine will probably be in abeyance for several months. The *Times* of July 15 says:—

> Some remarkable wireless signals were exchanged during the voyage of the R 34. The Royal Air Force station at Dundee exchanged signals at 1000 miles. The R 34 sent messages at 1100 miles that were read by the Air Ministry and by Wormwood Scrubs at 1135 miles, and by Ballybunion at 1600 miles. In one case, when the R 34 was approaching America, a signal was sent to her from the Air Ministry through Clifden, and a reply received *via* St. John's, Glace Bay, Clifden, and Marconi House, and then to the Air Ministry, all in twenty minutes—a very fine example of wireless telegraphy work.

The double crossing of the R 34 must be regarded as a very great achievement in the history of aeronautics, a flight of 7600 miles in two stages being an enormous advance on previous records. The airship has also abundantly proved its capability to withstand fairly severe weather without mishap. The possibility of commercial trans-Atlantic airships seems to be mainly governed by the question of speed. The cost of transport is at present very much higher for aircraft than for even the most rapid means of land and sea communication, and it is only in virtue of high speed that aircraft will find their use in the commercial world—at any rate for the next few years. The question is further complicated by the fact that airships may meet adverse winds having velocities equal to, or even greater than, their own maximum speed, whereas the ocean liner has only to contend against currents of very low velocity compared with its own steaming speed. The airship, like the steamship, is most economical to run at low speeds, and analogy would lead one to expect that only by greatly increasing the size of airships can high speed and commercial success be attained, exactly as has been the case with the ocean liner. Whatever the future may hold in store, we cannot fail to admire the wonderful achievement of the R 34,

the first aircraft to journey from the Old World to the New and back again, and we extend our heartiest congratulations to Major Scott and his crew on the unqualified success of their remarkable flight.

NOTES.

On July 11—the eve of his seventieth birthday—Sir William Osler, Regius professor of medicine in the University of Oxford, was presented with a collection of essays contributed by representative members of the profession on both sides of the Atlantic—physicians, surgeons, physiologists, anatomists, pathologists, and historians—to the number of one hundred and fifty. The presentation was made before a large audience at the house of the Royal Society of Medicine by Sir Clifford Allbutt, Regius professor of physic in the University of Cambridge, who said that though the last years had been a time of war and desolation, yet through the clamour and destruction Sir William Osler's voice among the voices in the serener air of faith and truth had not failed; nor had he grown weary in labouring for the sufferings of others. In Sir William Osler was to be seen the fruitfulness of the marriage of science and letters and the long inheritance of a culture which, amid the manifold forms of life, had survived to inspire and adorn a civilisation which so lately had narrowly escaped the fury of the barbarian. Sir William Osler, in reply, said that two circumstances deepened the pride he felt at this demonstration of affection by his colleagues on both sides of the Atlantic; one, that amid so much mental and physical tribulation his friends should have had the courage to undertake this heavy two-volume task, and the other that this honour was received at the hands of his brother Regius professor, a friend of more than forty years. He had deeply appreciated the loyal support of the large circle of men with whom his contact had been through the written word, the general practitioners of the English-speaking world. A vote of thanks to Sir Clifford Allbutt, moved by Sir D'Arcy Power and seconded by Sir Donald MacAlister, was carried by acclamation. The volumes have not yet been issued to the subscribers, and subscriptions may still be sent to the English publishers, H. K. Lewis and Co., 136 Gower Street, W.C.1.

By the death of Sir John Brunner on July 1 the world has lost, not only a great industrial leader, but also a man famed for his wide sympathy with, and his practical support of, national schemes for the improvement of the conditions of labour, no less than for the development of scientific education and research. It is no small thing in this country that a man of wealth should endow the university of his native city with three professorial chairs in physical chemistry, in economic science, and in Egyptology. Born at Everton in 1842, Sir John Brunner was trained in the Unitarian school which his father, son of a Protestant minister at Zurich, had opened in Liverpool. At fifteen he began his business career in a shipping office, and at twenty entered the chemical works of Messrs. Hutchinson and Earle at Widnes. Here he began that association with Dr. Ludwig Mond which was destined to revolutionise the alkali industry. Convinced of the economic advantages of the Solvay system, the two joined forces and started making soda by the ammonia-soda process in 1873 at Winnington, Cheshire. How "Brunner, Mond's" overcame its first difficulties owing to the business capacity and the chemical genius of the partners, and how the firm absorbed neighbouring works at Lostock-Gralam, Middlewich, and Sandbach, which, adding their output to that of their ever-growing parent at Winnington, gradually made it the largest in the world, makes one of the romances of industrial science. If before the war Sir John Brunner preached reduction of armaments at home and a friendly understanding with Germany abroad—and his critics have not failed to remind the world of the fact—it is fair to record that *in the war* no firm was in a finer position to turn its magnificent resources to the supply of high explosives, and no firm made a more wonderful or more successful effort to do so than the firm founded by Sir John Brunner.

The Civil List pensions granted during the year ended March 31 last, under the provisions of the Civil List Act, 1910, includes the following:—Mrs. Edith Harrison, in consideration of the services rendered by her late husband, Col. W. S. Harrison, in connection with inoculation against enteric and typhoid fevers, 50*l.*; Mrs. Cash, in view of the contributions of her late husband, George Cash, to the study of Scottish topography, 50*l.*; Mr. William Cole, in view of his contributions to the study of natural history and to scientific education, 50*l.*; Mrs. R. O. Cunningham, in view of the services of her late husband, Prof. Cunningham, as naturalist on board H.M.S. *Nassau* during the survey of the Straits of Magellan and the west coast of Patagonia, and as professor of natural history in Queen's College, Belfast, 50*l.*; Mr. Benjamin Harrison, in view of his devotion to scientific work (in addition to his pension of 26*l.* a year), 25*l.*; Mrs. E. A. Mettam, in view of the distinction of her late husband, Prof. A. E. Mettam, as professor of pathology and bacteriology, and of his contributions to veterinary science, 75*l.*; Miss Helen Tichborne, in view of the late Prof. Tichborne's scientific discoveries in chemistry and pharmacology, 60*l.*; Miss Eliza Standerwick Gregory, in view of her eminent services to botanical science, 60*l.*; and Lady Eleanor Charlotte Turner, in view of her late husband, Sir George Turner's services in the investigation and prevention of rinderpest, and in consideration of his death through contracting leprosy in the public service, 50*l.*

The Ministry of Ways and Communications Bill was read a third time in the House of Commons on July 10. Sir Eric Geddes, the Minister-Designate, announced the names of the prospective heads of departments as follows:—*Civil Engineering:* Sir Alexander Gibb, Civil Engineer-in-Chief, Admiralty, 1918. *Mechanical Engineering:* Lt.-Col. L. Simpson, R.E., Chief Mechanical Engineer in Charge of Railway Equipment and Rolling-stock of the British Armies in France. *Consultant Mechanical Engineer:* Sir John Aspinall, president of the Institution of Civil Engineers. *Traffic Department:* Sir Philip Nash, K.C.M.G. *Finance and Statistics:* Sir J. George Beharrell. *Development Department:* Rear-Admiral Sir Charles Martin de Bartolome, K.C.M.G. *Public Safety and Labour:* Sir William Marwood, K.C.B., Joint Permanent Secretary of the Board of Trade. *Roads Department:* Brig.-Gen. Sir Henry P. Maybury, K.C.M.G. *Secretarial and Legal:* Sir R. Francis Dunnell, K.C.B.

Capt. H. J. Page has taken up the appointment of research chemist and head of the chemical department of the Research Station and School of Horticulture of the Royal Horticultural Society at Wisley, Surrey, on his release from military service. Capt. Page is an 1851 Exhibition research scholar of University College, London, and was formerly on the staff there.

The Joint Committee of the Board of Agriculture and Fisheries and the Road Board appointed to consider the question of alleged damage to fisheries from

the washings of tar-treated roads has selected Mr. A. J. Mason-Jones as biologist and observer to assist with experiments, which will be commenced in the near future. Mr. Mason-Jones has had a distinguished academic career and considerable experience as naturalist on the staff of the Marine Biological Association. He has recently been engaged in a study of the biological conditions of fresh-water streams.

THE third annual meeting of the Association of British Chemical Manufacturers was held on July 10. The chairman, Mr. R. G. Perry, reported a membership of 145 firms, representing a capital of about 70,000,000*l*. In addition, seven kindred associations are affiliated to the association. During the year much useful work has been accomplished in consolidating the industry and strengthening the position of its various branches. The chairman pointed out that we are only on the threshold of a great dye industry in this country, and the council of the association has paid close attention to this question. A strong commission of the association, representative of all branches of the industry, has recently returned from, and reported comprehensively upon, its visit, under Government auspices, to the chemical factories in the occupied area of Germany. Chemical industry has derived great benefit from the activities of the association since its formation in 1916.

THE death of Mr. Albert Vickers, formerly chairman of Vickers, Ltd., occurred at Eastbourne on Saturday last. Mr. Vickers resigned his chairmanship last September on attaining his eightieth birthday. He was born in Sheffield, and entered his father's business in 1854. After a few years in the United States he returned to this country, and took charge of the commercial side of the business. The success with which the firm has met the enormous demands made upon it during the war is striking testimony to the soundness of the policy pursued by Mr. Vickers. The construction of guns began with the introduction of Mr. (afterwards Sir Hiram) Maxim in 1883, and orders for large guns were secured from the Admiralty in 1888, as well as orders for armour-plate. A further development took place in the direction of enabling the firm to carry out the complete construction of products, *e.g.* battleships, instead of furnishing steel, etc., to other constructional firms for this purpose. The Naval Constructional Works at Barrow-in-Furness were absorbed in 1896, and the Maxim-Nordenfelt Works in 1897. Others followed until the company became independent of outside supplies, and the capital increased from 155,000*l*. to more than eight millions sterling, and the workers from 1000 to more than 100,000.

WE are glad to note that the publication of the *Quarterly Journal of Experimental Physiology* has been resumed after suspension during the past year. The editors announce that it is intended that the journal shall now again appear regularly. Of the eight papers in the present issue (vol. xii., No. 2, May, 1919) we have space to note only certain conclusions in one. Prof. P. T. Herring finds that the suprarenals of the young adult female white rat are normally some 40 per cent. heavier than the suprarenals of male animals of the same body-weight, and that the adrenalin content of the suprarenals of the female white rat is rather more than twice that of the suprarenals of the male animal of the same size. The larger suprarenals and adrenalin content of the female white rat are associated with sex differences in the other endocrine glands and organs of the body (*e.g.* thyroid and pituitary).

CRAWLING medusæ, or jellyfish, with their tentacles modified to form what may fairly be called legs, have long been known, but they are rarely met with, and the discovery of a new species at the Cape of Good Hope is a matter of considerable interest to zoologists. Dr. J. D. F. Gilchrist describes this species under the name *Cnidonema capensis* (*Quarterly Journal of Microscopical Science*, vol. lxiii., part 4), instituting a new genus for its reception, and associating with it generically four other southern species previously known. The medusa, which first appeared in a tank at the Marine Laboratory near Cape Town, is very small, usually less than 1 mm. in diameter. Its numerous tentacles divide, as usual in the crawling medusæ, into two branches, one of which is modified for "walking," while the other is provided with batteries of thread-cells and curves over the back of the animal. It is produced by budding from a small hydroid form, with a verticil of three capitate tentacles around the mouth, and a second verticil of six non-capitate tentacles lower down, which was also found in the aquarium.

MR. J. RUNNSTRÖM has made at Monaco and at Bergen some very careful observations on the movements and physiology of sea-urchin larvæ, now published in Bergens Museums Aarbok, 1917–18. Locomotion is generally in spirals or in large curves, accompanied by a revolution of the larva, so that the course reminds one of the moon's orbit. This is effected by the cilia, chiefly of the processes and epaulettes, but also of the general body-covering, and the curves are due to greater intensity of action on one side or the other. The direction of motion is affected by light, and by chemical or other stimuli. The course of the ciliary currents which convey food to the mouth is also studied, and they are found to have some selective power, not, however, free from error. The food-particles when they reach the œsophagus are retained by a slimy secretion, and are carried further by ciliary currents, the course of which is described. In his remarks on the action of the larval water-vascular system, Mr. Runnström mentions that the hydropore is at first on the left, but closes, and a new hydropore opens on the median line. There are many other points in this detailed study which should be of interest to general physiologists as well as to students of Echinoderms.

TWO areas in the forest-lands of eastern Canada, easily accessible from the growing cities to the south, have been recently described by the Geological Survey of Canada. In Memoir 95 Mr. W. H. Collins deals with the Onaping map-area, and describes some interesting rocks from the pre-Huronian schist-complex, including what he believes to be the first discovery of variolite in Canada. He refers the cliff-bordered linear valleys of the district to faulting, and Mr. M. E. Wilson, in Memoir 103, on Timiskaming County, Quebec, comes to the same conclusion. These valleys are pre-Glacial, and are probably due to a Pliocene uplift. It may be remarked that similar valleys of recent origin in Finland are also ascribed to earth-movement acting on the hard pre-Cambrian rocks. The cliffs are thus uneroded fault-scarps. On both shores of Lake Timiskaming the passage from the Lorrain granite to a quartzite of the Cobalt series, through an arkose that represents the soil-surface of early Huronian times, is an interesting feature of the region; exploration is as yet practically confined to the waterways. The first hint of the mineral wealth of Canada was given when the veins of galena on the lake-side at Anse de la Mine were indicated on a map published in 1744.

PERSIA's mineral wealth is great, but the greatest yet discovered is mineral oil, the exploitation of which will shortly be commenced (*Allgemeine Oesterreichische*

Chemiker- und Techniker-Zeitung, December 1, 1918). Deposits of unknown value underlie the extensive oil-field of the Irak districts. Trial borings have shown an oil-bearing tract of more than 1000 sq. km., apparently capable of yielding a larger output of oil than the Baku wells, and of better quality. The northern limits of the oil zone lie in the province of Kermanshah; to the east it reaches to near Ispahan, runs diagonally across Arabistan, continues along the border hills of Dashti and Dashtistan behind Bushehr, the most important of the Gulf ports, and ends in the neighbourhood of Banda-Abbas, the terminus of the great caravan-route, Meshed-Kirman. Borings made in 1890 proved the existence of rich oil deposits in the Island of Kishem, off the coast. Since that date great progress has been made in developing the industry. Persian oil is said to be superior to the American; it contains a large percentage of benzene and kerosene.

A writer in *Zeitschrift für Instrumentenkunde* (November, 1918) describes a series of tests made on a Benedick galvanometer of the differential type to determine the cause of variations in its zero reading. The instrument is of the d'Arsonval type, the moving coil being suspended by a quartz fibre and the current led in and out by four thin metal ligaments. Tests show that the sensitiveness depends on the curvature of the pole-faces, and an analysis of the results with the aid of the equations of motion of the movement shows that the change is due to an alteration in the restoring force. As the suspension was unaltered during the test, it follows that the effect is due to magnetic action. This action is caused by the presence of traces of iron in the copper winding. This assumption is borne out by tests, which are described, showing the change in sensitiveness due to varying the position of the moving coil in the field. There is an after-effect causing a permanent motion of the zero of the instrument in the direction of the last deflection.

A paper by Messrs. F. B. Silsbee and R. K. Honaman, of the United States Bureau of Standards, which appears in the Journal of the Washington Academy for May 4, summarises the results of their work during the last two years on the relative merits of the various insulating materials used in sparking-plugs. Cup-shaped vessels of the materials were tested between 200° and 900° C. in an electric furnace, the resistivity being determined from the fall of potential between the molten solder inside and that outside when a measured current passed through the cup. Measurements with direct currents were found to be useless owing to the polarisation produced, but with alternating currents of 60 cycles per second the results for the same specimen were always consistent. At 500° C. the resistivities of a few typical materials in megohms per cm. cube are:—Fused silica 340, best porcelain 80, typical mica 70, aeroplane plug porcelain 40, motor-car plug porcelain 0·8. A minute quantity of impurity in the material appears to reduce the resistivity considerably. The change of resistivity with temperature is given by $\log_{10}R = c - bT$, where R is the resistivity, c is a constant between 10 and 12, and b a constant between 0·0065 and 0·0085.

In the science reports of the Tohoku Imperial University, vol. vii., No. 3, there is an account by Murakami of an investigation of the structure of ferro-carbon-chromium alloys. By utilising methods of magnetic analysis and microscopic examination, alloys containing less than 6 per cent. of carbon have been systematically investigated, and a structural and constitutional diagram of their normal states has been obtained. The author confirms the existence of a compound Cr_4C, having a hexagonal crystalline form as put forward by Moissan. The influence of this carbide on the A_1 change in steels has been investigated. Above this point the carbide dissolves in austenite, and, on heating to a high temperature, it dissociates as follows:—

$$2Cr_4C = Cr_3C_2 + 5Cr.$$

During cooling the reverse change takes place only slowly, and this influences the position of the transformation point. On one hand, if the rate of cooling is sufficiently slow, the change occurs at about 700° C.; while on the other, if it is quick, the transformation point is very conspicuously lowered, and in extreme cases completely suppressed. A specimen having a normal transformation point shows a pearlitic or troostitic structure, one having a lowered transformation point a martensitic structure, and when the transformation is suppressed an austenitic structure. The self-hardening of a chromium steel is related to the lowering, or, in extreme cases, the suppression, of the A_1 transformation, and hardness is caused by the solid solution of the carbide Cr_3C_2 in iron and chromium. The author has come to the conclusion that there are three ternary compounds, namely, α, β, and γ double carbides. The micrographic and magnetic characteristics of these compounds have been investigated by him.

The results of some interesting tests on locomotive piston-valve leakage are given in *Engineering* for July 4. The tests were conducted by the test department of the Pennsylvania Railroad at Altoona, and have extended over several years; a specially arranged testing plant was employed. The results were erratic, and the following abstract of some of the results takes account only of all that appeared normal. With a standard two-ring valve, 12 in. in diameter, in plain bushing, the leakage at each end of the valve ranges between 171 lb. and 183 lb. per hour with saturated steam; between 194 lb. and 210 lb. with steam at 100° superheat; between 181 lb. and 197 lb. with steam at 200° superheat; and between 122 lb. and 132 lb. with steam at 300° superheat. For the bushing with ports a leakage between 302 lb. and 326 lb. per hour occurred with saturated steam; between 425 lb. and 448 lb. per hour for 100° superheat; and between 383 lb. and 414 lb. per hour for 200° superheat. The length of valve-travel, when it ranged between 2 in. and 6 in., was found to have but little effect upon leakage. The speed of the valve (strokes per minute) had no appreciable effect upon leakage. As much as 15 h.p. was required to drive the valve in tests at 300 revs. per minute.

Messrs. George Allen and Unwin, Ltd., have in preparation "Defective Housing and the Growth of Children," by Dr. J. L. Dick. Three lectures recently delivered before the University of Cambridge are announced for publication by the *Cambridge University Press*. They are "Science and War" (the Rede lecture), by Lord Moulton; "Italian Studies: Their Place in Modern Education," by Prof. T. Okey; and the Leslie Stephen lecture on Pope, by Dr. J. W. Mackail. The same publishers also promise a revised edition of Dr. A. Harker's "Petrology for Students." *Messrs. Longmans and Co.* announce for publication in the autumn a new book, limited to 105 copies, by A. Thorburn, entitled "A Naturalist's Sketch-Book," containing 60 plates, 24 in colour and 36 in collotype. It will form a companion volume to the same author's "British Birds." Among other books in the press for appearance by Messrs. Longmans we notice "An Introduction to General Physiology," Prof. W. M. Bayliss; "The Principles of Child Physiology, Pure and Applied," Dr. W. M. Feldman; "The Physiology of Muscular Exercise," Prof. F. A. Bainbridge; "Cement," B. Blount; "Applied Aero-

dynamics," L. Bairstow; "Aeroplane Structures," A. J. S. Pippard and Capt. J. L. Pritchard; "The Design of Propellers for Aircraft," H. C. Watts; "Telephonic Transmission, Theoretical and Applied," J. G. Hill; "Principles and Practice of Electrical Testing as applied to Apparatus, Circuits, and Machines," R. G. Allen; "Engineering Machine Tools and Processes," A. G. Robson; and "Efficient Boiler Management," C. F. Wade.

ERRATUM.—We regret that in the article on "Some Recent Atomic Weight Determinations" in NATURE for July 3, p. 346, the name of Prof. T. W. Richards was incorrectly given as "Theodore Williams," the surname being omitted.

OUR ASTRONOMICAL COLUMN.

THE MOVEMENT OF THE EARTH'S POLE.—The issue of *Scientia* for July contains an article by the Astronomer Royal on this subject, which comprises a concise statement of the movement predicted by Euler, and of suggestions that have been made to show why the observed movement does not conform to this. The Eulerian principle enunciates that the axis round which the earth would turn, assuming it to be a rigid body set spinning about an axis other than the axis of figure, would always point in the same direction in space (*i.e.* among the stars) within a very little, but would describe a cone in the earth in a period of 305 days, the radius of the circle described by the wandering pole being about 10 metres. Observations show that the movement is compounded of two circular motions of periods of a year and of 432 days respectively. Sir Frank Dyson writes that the dynamical causes underlying these movements are probably to be found in the changes of distribution of matter on the earth, and quotes Newcomb, who thought the amplitude of the Eulerian movement was increased or diminished irregularly by meteorological changes. Mr. Harold Jeffreys has lately shown that a shift of matter symmetrical about the earth's axis will not have any effect in shifting the earth's axis of rotation, and looks for the cause in an unsymmetrical increase of mass, such as is caused by the high barometer over Siberia in the winter, which, however, is not sufficient of itself to produce the observed effect. The lengthening of the free Eulerian period from 305 days, on the assumption of a rigid earth, to 432 days supplies information as to the possible amount of elasticity of the earth.

THE MASSES OF BINARY STARS.—There is a well-known formula by which the total mass of a binary system can be found if the parallax is known, as well as the elements of the orbit. The modern method of deducing stellar parallax by examination of the spectrum therefore provides much data for determination of mass, and Prof. Aitken, of Lick Observatory, has lately (Pub. Ast. Soc. Pac., June) used the parallax of twelve binaries taken from Messrs. Adams and Joy's list to find their masses. These had been already found by help of the trigonometric parallax, and though considerable discordance was shown for individual systems, the agreement of the mean mass of the twelve binaries, which was 1·61 times that of the sun by the one method and 1·67 times by the other, showed that the new parallaxes might be considered trustworthy for mean results. Prof. Aitken, therefore, determined the mass of seven other stars which are common to the list above cited and his own list of binary systems. These, with Sirius and α Centauri and the twelve before mentioned, make a list of twenty-one systems the mass of which is known. They range from 0·21 to 7·21 times that of the sun, the mean value being 1·88; and though some of the individual mass-values must still be regarded as uncertain, the mean result may be taken as confirmatory evidence that the short-period visual binary systems near to us are about twice as massive as our sun. It may be noted that five stars of classes K and M are, on the average, only half as massive as the sixteen stars of classes A to G, and are, on the average, nearly four magnitudes (absolute) fainter.

SCIENCE IN INDUSTRY.

LECTURES AT THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

SIR WILLIAM TILDEN, in his lecture on "Chemistry in Reconstruction" at the British Scientific Products Exhibition on July 7, remarked that a visitor to the exhibition could not fail to experience the comforting conviction that British chemical manufacturers are now quite capable of holding their own in regard to quality and variety of products. They will undoubtedly be able to supply the wants of this country if they continue to exhibit the same skill, energy, and resource which have been gradually developed during the last five years, and to be protected for a time from foreign imports. With regard to trade outside the United Kingdom, it is too soon to indulge freely in optimism. The Prime Minister, in his recent speech in the House of Commons on the Peace Treaty, pointed to the condition of German territory, which has not been damaged or disturbed to any appreciable extent by the operations of the war, and still retains the famous chemical establishments with plant and machinery in working order, and even increased in power by the material stolen from Belgian and French factories. Moreover, Germany has the services of a very large body of technical chemists of great skill and experience. Germany will, naturally, make greater efforts than ever to penetrate into foreign markets. Then there is Switzerland, with good schools of chemistry and an already established chemical industry. The United States of America during recent years has vastly extended the chemical departments of its universities and technical schools, and devoted huge sums to the development of chemical manufactures. Japan also with a well-equipped university and many natural products, combined with cheap labour, will certainly appear in the field.

All these will undoubtedly prove very formidable competitors in the race in which the British chemist will have to enter. In this country also there is still a great deficiency in the number of well-qualified chemists available for the service of industry. The manufacturer has too long been satisfied with the services of the laboratory boy, who can be taught to perform routine testing without any knowledge of more than the most elementary chemical principles. We require a large number of well-educated men equipped with the fullest possible knowledge of modern chemistry in every branch. Lord Crewe referred at the opening of the exhibition to the several methods which have been so far employed for converting the academic into the industrial chemist. There can be little doubt that this is best accomplished in the works, and in the long run manufacturers will find it pay best to employ the academic chemist thoroughly drilled in the practice of analysis and well acquainted with all the methods of research, who must be assumed also to possess common sense, and give him facilities for gaining that knowledge of constructive materials and elementary engineering which is requisite for his work.

The exhibition contains a most instructive and

encouraging collection of definite products, the manufacture of which on a large scale has been made possible in the British factories during the last five years, when the chemical skill and energy available were largely absorbed in the business of making explosives and other war material. This is very satisfactory, but the applications of chemistry, apart from the manufacture of definite products, must not be overlooked. Examples of such application are to be seen on every side, in metallurgy, in agriculture, in physiology and medicine, in the treatment of water, and in sanitation.

Sir William Tilden concluded his lecture by pointing out that one great feature of modern chemical manufacture is the production by synthetic processes of compounds which hitherto have been derived from natural sources. Of these the most remarkable is the production of ammonia by combination of hydrogen with atmospheric nitrogen, which, notwithstanding the physical difficulties, is likely to proceed on a very large scale. Another case of a different kind is the production of rubber which has been going on in Germany during the war. There can be no doubt that in a few years this substance will appear on the market provided the initial material, at present acetone, is available at a sufficiently cheap rate. Synthetic rubber now obtainable in the laboratory costs about twenty times as much as the natural article from the plantation.

In his lecture on July 8 on the subject of transmitting and picking up sounds in water, Prof. W. H. Bragg first made clear the great difference between the noisy air-world above the sea and the quiet, almost soundless world below the waves. This is all the more remarkable in view of water being a much better carrier of sound than air. Being specially engaged during the war on an investigation of submarine sounds, he had visited the Zoo to study fishes and their hearing or sounds produced by them. Their powers were, however, found to be so deficient as to suggest that lack of noise in their movements under water had rendered acute hearing valueless to the fish in its struggle for existence, either as the hunter or the hunted. By means of gramophone records, lent by the Admiralty, Prof. Bragg showed how the silent submarine world was disturbed by the movements of ships or by the breaking of waves on the coast, and how difficult it was, among the loud noises made by neighbouring propellers, to distinguish the faint sounds caused by a submarine. The hearing of these was the real object in view, and a record of the German submarines entering Harwich was used to show their special character.

Some of the means used for locating the source of the sounds were also described, and a full-sized "hydrophone" was shown, consisting of a diaphragm carried in a heavy iron ring and shielded on one side by a special plate of xylonite enclosing several air-cells, which so blocked the sound-waves coming in that direction as to form the equivalent of turning a deaf ear in one direction. Lantern-slides were shown taken from kinema-films which illustrated graphically the vibrations received by a microphone placed at the centre of such a shielded diaphragm. Prof. Bragg's explanation of the films led to a most interesting deduction as to the post-war value of these investigations. He showed a film on which appeared six parallel records of receiving galvanometers representing the conditions at six different stations. Each station was equipped with such a hydrophone and connected up electrically to the galvanometer, which recorded their vibrations on the film as lines, which in this case remained perfectly even until a destroyer, sent straight out to sea for the purpose, exploded a depth-charge. As the sharp sound-wave sent out thereby reached each hydrophone, the corresponding line broke up into oscillations, and the moment at which these oscillations began was clearly indicated to a thousandth of a second by their position on the film, giving the exact time of arrival of the sound-wave at each hydrophone. The speed of sound in water being also well known, the position of the ship at the time of each explosion could therefore be ascertained.

The greatest distance recorded on the film was seventy-five miles, but the undiminished accuracy of its indications proved that the method of locating ships at sea would be successful at much greater distances, and at the present time it has been developed up to a range of 230 miles, with no sign of falling off in its efficiency. On shorter distances it has been found possible to signal with a simple detonator instead of the 40-lb. charge used in the first experiments. These preliminary successes open up a most promising field of practical applications, especially in coastal surveys and the exact location of rocks and shoals. At present it is being largely used in the North Sea, several stations being at work on the east coast of Britain. It has also been successfully used for the exact location of ships and aircraft during fog.

The lecture on "Coal Conservation" given by Prof. H. E. Armstrong on Friday, July 11, was a protest against the legislation foreshadowed in the Electricity Supply Bill now before the House of Commons as both premature and narrow, and a plea for a complete inquiry into the uses of coal, with the view of co-ordinating the various interests and the ultimate comprehensive treatment of all the industrial issues. Prof. Armstrong favours the production of a smokeless fuel, with the object of abolishing the smoke nuisance and also of saving the valuable volatile products which are wasted in burning raw coal. He would therefore have the use of raw coal entirely disallowed in the near future; in view of the prospective world-shortage of petroleum, it will be criminal folly if we fail to produce all the oil-fuel that it is possible to obtain by subjecting coal to a preliminary distillation at a relatively low temperature. He is an advocate of the establishment, at least in the larger towns, of fuel and power centres charged with the supply of all the forms of fuel and power required by the public within their areas. Coal should be carbonised at these centres in such a way as to secure the recovery of the maximum proportion of by-products, which might be in part distributed and in part further utilised at the centre in generating electric current. The advantages attending the use of an easily combustible solid fuel instead of gas as a domestic heating agent were insisted upon. In the subsequent discussion this recommendation was strongly supported by Prof. Bone, who spoke against the suggested provision of gas-heating appliances alone in the improved dwellings which it is contemplated to provide for the use of the masses. Whilst suitable for kitchen and occasional use, gas is not only much more costly than solid fuel but also a far less healthy means of heating dwelling-rooms over any considerable period. The scheme suggested would render possible the supply of a heating gas of higher quality than is now contemplated by the gas interests; for if the whole of our bituminous coal were carbonised at a low temperature, a large amount of rich gas would be produced which would bear dilution with "water-gas" and yet be superior as a calorific agent to that which the gas companies can provide in existing circumstances. The advantages the scheme has are such that, ere long, electricity should entirely supplant gas as an illuminating agent.

AMERICAN ASTRONOMY.

In the year 1840 the Dana House Observatory of Harvard College was established by the aid of public funds and private subscription, with William Cranch Bond as director. It was not the first college observatory in America, and other eminent American astronomers had lived earlier in the century, but the date may be taken as the beginning of systematic astronomical observation in the Western continent. The U.S. Naval Observatory was established in 1844, and the present Harvard Observatory founded, largely by generous help from private benefactors, in 1846. Other institutions of the period might be named where the science of astronomy of position was pursued, and this, with the splendid work on planets, satellites, comets, asteroids, nebulæ, and the astronomy of the solar system generally done at Harvard by W. C. Bond and G. P. Bond, and afterwards by Winlock, is to be considered representative of the astronomy of the United States in the succeeding forty years. The accession of the late Prof. E. C. Pickering to the directorate of the Harvard Observatory in 1877 marks the beginning of the astronomical era in which we now live. Spectroscopy, stellar physics, and stellar statistics are the principal features. Prof. Pickering's work was stellar photometry on a wholesale scale. Stellar spectroscopy and the determination of the radial velocity of stars by its means had been begun by Huggins in 1864; the photographic plate came into general use as an adjunct to the astronomer's equipment in the decade 1880–90, and these three items have formed the basis of the work of the American observatories of recent creation. The Lick Observatory, with the 36-in. telescope, was completed in 1887 at the expense, as everyone knows, of an American business man. The Yerkes Observatory came into existence in 1897, and the observatory at Mount Wilson in 1904. These things are recalled at this moment because, during the past week, English astronomers have been gratified by a visit from a delegation of astronomers from across the Atlantic who were on their way to take part in the establishment of an International Astronomical Union at a conference now being held in Brussels (July 18–28).

At a meeting of the Royal Astronomical Society on July 11, specially arranged for the purpose, the visitors spoke in turn of the work on which they are each engaged, and the contrast between the astronomy of to-day and of sixty years ago is apparent. The absolute magnitude of a star or its actual luminosity independent of its distance is now a commonplace, and forms the subject of many investigations. Certain peculiarities of spectrum have been correlated with the absolute magnitude in cases in which the latter is known, and, generalising from this, a method has been devised for finding from the spectrum the absolute magnitude, and therefore the parallax, of stars. Prof. W. S. Adams, to whom this conception is due, was constrained to say that the data on which his first list of parallaxes was based are capable of improvement, but this research is as yet in its early stages. Dr. Seares, also of Mount Wilson, has devised new photographic methods for determining the colours of stars, and a correlation between colour, spectral type, and absolute magnitude is being established. Prof. Benjamin Boss, of the Dudley Observatory, whose name is associated more with geometrical astronomy than with physical, had some interesting facts to tell about the difference in direction of motion of the classes of stars known as the Giant and Dwarf, which is a distinction depending on luminosity.

Dr. Schlesinger, of Allegheny, and Prof. Joel Stebbins gave details of their work in determining the variation of brightness of variable stars, the method of the photo-electric cell used by the latter being a very recent adaptation of physics to astronomy not unknown in England; whilst Prof. Campbell, director of the Lick Observatory and president of the delegation, refrained from speaking of his well-known observations of radial velocity, but told his audience of the observations of the Lick Observatory party on the occasion of the eclipse of June 8, 1918. An attempt was made to detect the Einstein effect, or a light-displacement effect from any cause, by comparison of a photograph of the stars round the sun with a photograph of the same field in the night sky, but the comparison failed to show any displacement of this nature. It is regrettable that the Harvard Observatory was not represented owing to the recent death of Prof. E. C. Pickering.

This brief sketch of the proceedings at this meeting is sufficient to show the trend of modern astronomy. It was impressing to see so many men, comparatively young, who are devoting themselves to abstract science. That there is similar progress on this side of the Atlantic reference to recent volumes of the Monthly Notices will show. Here, as counterpart to the brilliant invention of new methods of attack by observation above recorded, we have development by mathematical theory and the statistical discussion of results.

THE MUSEUMS ASSOCIATION.

The thirtieth annual conference of this association, held at Oxford on July 7–10, under the presidency of Sir Henry Howorth, showed the return of peace conditions in a particularly large attendance. An important discussion was opened by Mr. E. E. Lowe on a recent recommendation by the Adult Education Committee of the Ministry of Reconstruction that the control of municipal museums (including art galleries) should be transferred to the local education authority. While this recommendation was supported by two officials of the Board of Education, who spoke in their private capacity, it was opposed by all the museum curators and by several members of museum committees, some of whom also served on education committees. Though museum authorities are, as they long have been, anxious to co-operate fully and intimately with schools and other educational institutions, they feel that many of their important functions cannot properly be described as educational, and they deprecate any form of control that would obscure this fact. On the other hand, they would welcome assistance and inspection by a separate museum department that should link up all the museums of the country and be directed by men familiar with museum work. A special committee was appointed to draw up a statement on behalf of the museums, and, if possible, to arrange conferences with the Government Departments concerned.

For some years the association has been trying to induce British manufacturers to provide for museum purposes glassware of a quality equal to that previously procurable only from Germany. Under war conditions no great success has attended its efforts, but Messrs. Standley Belcher and Mason, Ltd., of Birmingham, now submitted a small flat-sided jar which appeared suitable. Trial orders were solicited, and, to attain a reasonable price, it is important that museums and laboratories should support the association in this matter. Communications may be addressed to Mr. E. E. Lowe, Leicester Museum. In this connection it was of interest to learn from Mr. Renouf, of Rothesay, that when he wanted some trimmed glass squares he was told that there was no glass-planing machine in Great Britain. There are

some things we must have, and we do not want to be driven back to Germany for them, but our manufacturers must wake up.

These glass squares were for mounting marine animals in formalin under large watch-glass covers—a mode of exhibition that had proved effective and durable. Mr. Renouf also explained a method of cutting large holes in glass with a screw-tap, and recommended Steubner's waterproof ink for injecting fine blood-vessels. Mr. Rowley described an exhibit for children in the Exeter Museum; Mr. Lowe showed a revolving frame for exhibiting coins; Mr. Carline discussed open-air folk-museums; and Prof. Myres advocated the preservation of objects rapidly changing under present conditions. Profs. Poulton, Sollas, Bourne, and Bowman vied with Messrs. Balfour, Hogarth, and Leeds in demonstrating the riches and methods of their respective museums and departments.

Sir William Martin Conway was elected president of the association for the coming year, and the new secretary is Dr. W. M. Tattersall, Manchester Museum

THE NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

WITH the view of honouring some of those who helped to win the war, of recording the work done on the North-East Coast for the war, and of commemorating those members of the institution who fell during the war, the North-East Coast Institution of Engineers and Shipbuilders held a Victory meeting at Newcastle-upon-Tyne on July 8–11. The honorary fellowship of the institution was presented to the Hon. Lady Parsons, Marshal Foch, Sir David Beatty, Sir Douglas Haig, Lord Weir, and Sir Joseph Paton Maclay.

Lady Parsons read a paper on women's work in engineering and shipbuilding during the war. The record of skilled work done by women given in the paper controverts the impression which many people have that women are only capable of doing repetition work on fool-proof machines. There is no doubt that many women developed great mechanical skill and a real love of their work. The engineering industry is again barred to women by an agreement made between the Treasury and the trade unions, with the result that women wealth-producers are scrapped. The meeting agreed with Lady Parsons's condemnation of the Labour Party, which, while demanding full political equality for women and their right to sit in the House of Lords and to practise at the Bar and as solicitors, will not grant to women equality of industrial opportunity.

Mr. A. H. J. Cochrane gave a short record of the work of the principal industries of the North-East Coast during the war. There have been two important developments in marine engineering for which the war period is partly responsible. These are the increased and increasing use of speed-reduction gearing in turbine-driven sets—the output of gearing by one firm during 1915–18 amounted to 2,830,000 shaft-horse-power—and, secondly, the high standard of accuracy which has been reached in the design, construction, and installation of turbine machinery. This efficiency has enabled the Admiralty to dispense with exhaustive preliminary trials of machinery. Probably the most remarkable case cited in the paper is that of the destroyer *Nonsuch*, which, under conditions of emergency, actually raised her full power within seven minutes of leaving the piers. It is also of interest to note that the total stoppages of work due to raids and raid-alarms amounted to 47 hours 24 minutes during the whole war period of 221 weeks. The total output was 1130 vessels, with a tonnage of 3,324,912, which gives an average of five ships per week.

A long paper on developments in aircraft design and application during the war was read by Lord Weir. The section dealing with future developments is of special interest. An outbreak of war should see us with the very best designs of engines and aircraft, tried and tested, and with a manufacturing nucleus on which war production may be readily expanded. In civil aviation the more immediate problems of international and domestic aerial legislation have been provisionally solved by the International Aerial Convention and by the Civil Aviation Act, and it is gratifying that in both these directions Great Britain has taken the lead and shown the way. In another direction much remains to be carried out quickly. We possess fleets of aircraft of trustworthiness and of great performance possibility, but our navigational facilities are still almost non-existent, and herein lies one of the main fields of action of our new Department of Civil Aviation. The two qualities of outstanding merit in the new form of transport are speed and independence of action as against land transport requiring roads or rails. Speed in transport is associated with high cost, and speed will always command a high value. Early action should be taken in regard to a few main routes, especially in countries with equable weather conditions, and in new countries backward in rail development. Two such main routes would be Egypt to India, and Egypt to South Africa.

Lt.-Com. Norman Wilkinson gave some interesting particulars regarding his methods of dazzle-painting of ships, from which it appears that the object was not to secure invisibility, but to perplex submarines in the attempt to determine the precise course of the "dazzled" ship. The author, who is a marine painter of long experience, does not consider it possible to secure invisibility at sea. Success in submarine attack depends upon the attaining of a position which enables the attack to be made, and if a submarine once fails to secure the favourable position it is not likely to have a second opportunity. Reports from other ships bear striking testimony to the value of dazzle-painting:—"The vessel, at a distance of two or three miles, appeared as a wreck." "At four miles' distance I decided it was a tug towing a lighter." "I was on the point of stopping my engines and going full speed astern to avoid a collision, when I discovered that she was altering course to starboard. After passing the vessel it was almost impossible to say how she was steering."

Sir Dugald Clerk gave a paper on the limits of thermal efficiency in Diesel and other internal-combustion engines. The author considers that conditions all point to ultimate success in the construction of large gas-engine units composed of many cylinders geared to a common shaft. Large cylinder engines, such as had been developed in Germany before the war, do not permit of very large unit powers except at an extravagant weight and cost, and have no chance of competing with the steam turbine.

The paper on ship repairing by Messrs. M. C. James and L. E. Smith contains many interesting photographs and descriptions of extraordinary and urgent repairs executed during the war.

One of the most valuable papers of the meeting was that on science and its application to marine problems by Prof. J. C. McLennan. Reference is made to the development of listening devices in the submarine campaign. An echo method consists in the use of a beam of sound-waves used in a manner analogous to the use of a searchlight. If an object of sound such

as a submarine happens to come within the beam, the sound-waves are reflected and echo effects are obtainable. Success has been obtained in the picking up and closing on a submarine situated more than a mile away. A very important application of an electromagnetic effect is the Leader gear. A cable is laid on the bottom of the sea along the course of a narrow, tortuous channel leading into a harbour or through a minefield. Alternating currents passed through the cable can be detected on the ship by aural or visual indications, and by these indications the ship can be guided in safety in fog or darkness at speeds as high as twenty knots almost with as much precision as a tramcar over a railway. In water of suitable depth experience shows that it is a simple matter to apply this method for distances as great as fifty miles or longer.

Invisible signalling by polarised light, or ultra-violet and infra-red radiations has been employed where it is not advisable to use wireless communication. In wireless methods, by the use of oscillating thermionic valves especially, great progress has been made. Some extraordinary advances have been made in the measurement of the pressure of explosive waves. Changes which take place in 1/100,000 of a second have been recorded by the method suggested by Sir J. J. Thomson and applied by Mr. D. A. Keys, in which the inertia of a beam of cathode-ray particles is made use of; such rays are deflected by electrostatic and magnetic fields. The advances made in the production of helium warrant the opinion that, had the war continued after November 11, 1918, supplies of helium at the rate of 2,000,000 cubic ft. per month would have been produced within the Empire and the United States, and helium-filled aircraft would have been in service.

It is impossible within the limits of our space to deal adequately with Prof. McLennan's paper, both as regards what science has done in marine problems during the war and the large number of suggestions he makes regarding the application of what has been discovered to peace conditions.

THE SIGNIFICANCE OF THE CEREBRAL CORTEX.

IN the series of Croonian lectures delivered at the Royal College of Physicians (June 12, 17, 19, and 24) Prof. Elliot Smith claimed that much of the obscurity concerning the meaning of the structure and functions of the cerebral cortex was due to the failure on the part of biologists and physicians to face the fact that the cortex is the organ of intelligence, and its chief significance of a psychical nature. It is no more possible to understand the cerebral cortex without recognising to the full its real purpose than it would be to explain the mechanism of an aeroplane if the investigator ignored the fact that the machine was made to fly.

The aim of these lectures was to discuss the means whereby the cerebral cortex acquired its supreme powers as the organ of intelligence. Dr. Henry Head's researches have given us a new vision of the meaning of nervous and mental processes, and have provided all workers in neurology with a new generalisation which compels them to review their own work in the light of the new illumination.

Much that was dark and unintelligible in the evolution of the cerebral cortex acquires a definite significance when the facts are examined in conjunction with the results of Dr. Head's clinical work and Prof. Sherrington's experimental researches.

The mammalian cerebral cortex, *i.e.* the neopallium, is the repository of past impressions, and these sensory dispositions profoundly modify the effect produced by the arrival of fresh impulses. But Dr. Head has shown that, in addition, "the function of the cortex in sensation is to endow it with spacial relationships, with the power of responding in a graduated manner to stimuli of different intensities, and with those qualities by which we recognise the similarity or difference of objects" that appeal to the senses. On the other hand, the appreciation of the affective side of experience, the pleasantness or unpleasantness, and the crude awareness, are functions not of the cortex, but of the thalamus.

Since the discriminative functions of the cortex are particularly associated with the neopallium, which is found in a fully developed form only in mammals, the first inquiry must be directed towards an understanding of the psychical activities of the classes of vertebrates other than mammals; and from such investigations the nature of the circumstances which called the neopallium into being must be determined.

The fundamental fact in the evolution of intelligence is the significant part played by the sense of smell. In the primitive generalised vertebrate it provided the animal with information of varied kinds, but of direct and obvious psychological meaning, by which behaviour was determined in respect of most of those activities that affect the preservation of the individual and the species, namely, the search for food and the appreciation of its quality, the recognition of friends and enemies, as well as of sexual mates or rivals.

One factor which added to the dominating influence of smell and emphasised the directness of its appeal was the result of the circumstance that in an animal living in the water the sense of smell was very nearly akin to that of taste. When such an animal scented food it got, so to speak, a foretaste of the satisfying consummation of the experience when the food was seized, tasted, and swallowed with a feeling of intense satisfaction. The whole incident, from the first anticipation of the pleasure in store until the satisfying consummation, was under the dominance of the sense of smell, which became more and more intensely stimulated as the animal approached its quarry, until it culminated in the gratification and the appeal to the sense of taste. The affective tone of the sense of smell linked into a connected series all the incidents of this experience. and the psychical integration that resulted formed the basis of the appreciation of time and space, of memory, the recall of the earlier incidents of the episode, and of anticipation, the end-result and the joyful consummation.

In the course of the pursuit of its prey the animal is subjected to the influence of many other circumstances that appeal to the senses of vision, touch, pressure, temperature, etc., and affect the organs of equilibration; and the effects of all these events tend to become involved in the process of psychical integration. When such information as is collected by these other sense-organs acquire some biological significance to the animal, the visual, tactile, acoustic, and other sensory tracts make their way into the cortex in increasing numbers: and they stimulate the growth and differentiation of such special receptive areas as the hypopallium and neopallium. But this does not happen until the reptilian stage of development is reached.

When, attracted by its scent, the primitive vertebrate (such as an Elasmobranch fish) is impelled to pursue its prey, it circles about in the search because at first it has no more exact indication of the position of the object of its pursuit than the relative intensity of the odour as the pursuer moves about. But when it comes within visual range it acquires a more precise

knowledge of its prey's exact position and movements in space; then it can direct its own course with greater directness and precision to its goal.

At first vision conveys little or no affective feeling or psychological meaning; it acquires this secondarily from the sense of smell. But the visual mechanisms in the brain control the direction of the animal's movements; and the receptive centre for the optic nerve (the tectum of the mid-brain) is put into direct connection with all the motor nuclei to effect this purpose. So far as influences from the outside world are concerned, smell determines the animal's behaviour, vision directs it, and the vestibular mechanism (cerebellum) provides the means by which the actions of the muscles can be co-ordinated to perform the movements in an orderly and useful way. As the result of these events the influences of all these other experiences are integrated with sensations of smell. Not only are vision, touch, the sensation of movement, etc., thus afforded the opportunity of participating in the mental life, but a fuller appreciation of spacial relations also is acquired by the animal as these other senses add their quota to the creature's knowledge, and obtain a fuller representation in the cerebral cortex as the means towards this end.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ABERDEEN.—Prof. A. Findlay, professor of chemistry, University College of Wales, Aberystwyth, has been appointed to the chair of chemistry in succession to Prof. Soddy.

BIRMINGHAM.—Mr. Humphrey F. Humphreys has been appointed lecturer on dental anatomy and physiology and curator of the Odontological Museum in succession to Mr. John Humphreys, who has resigned.

The Ingleby lecture for 1920 will be delivered by Mr. Beckwith Whitehouse.

Dr. B. Muriel Bristol has been awarded an 1851 Exhibition scholarship of the value of 200*l*. as a result of the excellence of her work on the algæ of soil, carried out in the botanical department during the past three years.

Dr. Nellie Carter has been awarded 150*l*. for the next session by the Department of Scientific and Industrial Research on the condition that she continues her research work under Prof. G. S. West in the University botanical department.

The Council has gratefully accepted from the family of the late Mr. W. H. Wilkinson, of Sutton Coldfield, a very valuable gift for the herbarium of the botanical department, consisting of a collection of lichens and the associated library collected by the late Mr. Wilkinson. The Council has received a further very valuable gift from Prof. West of the collections of mosses, hepatics, and lichens made by his father, the late Mr. W. West, of Bradford. This, combined with Mr. Wilkinson's collection, will give the University one of the finest collections of lichens in Britain.

BRISTOL.—The University has made the following appointments to the professorial chairs mentioned:—*Botany:* Dr. Otto Vernon Darbishire, lecturer in botany in the University. *Education:* Dr. Helen Marion Wodehouse, Principal of the Bingley Training College, Yorkshire. *Henry Overton Wills Chair of Mathematics:* Dr. H. Ronald Hassé, late fellow of St. John's College, Cambridge; senior lecturer in mathematics in the University of Manchester. *Mechanical Engineering:* Major Andrew Robertson. *Henry Overton Wills Chair of Physics:* Dr. Arthur Mannering Tyndall, acting head of the department of physics in the University during the war. *Henry Overton Wills Chair of Physiology:* Dr. George A. Buckmaster, assistant professor of physiology in the University of London.

LIVERPOOL.—A course of lectures on oceanography, open to the public, without fee, will be delivered by Prof. W. A. Herdman during the autumn and Lent terms, commencing on October 14.

Dr. Leonard Doncaster, F.R.S., has been appointed to the chair of zoology in the University. He is a fellow of King's College, Cambridge; was lecturer in zoology, Birmingham University, in 1906–10; special lecturer in heredity and variation at Cambridge in 1909; and University lecturer there in zoology, 1911–17.

DR. ADDISON, Minister of Health, has provisionally promised to deliver the inaugural address at the opening of the session at the London (Royal Free Hospital) School of Medicine for Women on Wednesday, October 1.

To a private deputation from the Education Committee of the Parliamentary Labour Party, who urged upon him the desirability of an inquiry into the organisation and financial position of the Universities of Oxford and Cambridge, Mr. Fisher has made the important announcement that the Government has decided to appoint Commissions to inquire into the position of the Universities of Oxford and Cambridge. At both Universities the existing resources have proved inadequate to meet the increased cost of maintenance of the various departments, and a few months ago the authorities of each independently applied to the Government for financial aid. In reply to these requests Mr. Fisher, on behalf of the Government, stated that such grants out of Parliamentary funds could be sanctioned only on the condition that in due course comprehensive inquiries into the whole resources of the Universities and their colleges and the use made of them should be instituted by the Government. The Cambridge Senate on May 31 authorised the Vice-Chancellor to inform Mr. Fisher that the University would welcome a comprehensive inquiry into its financial resources, and at Oxford a similar decision was taken by Convocation on June 10.

THE President of the Board of Education has appointed a Committee to inquire into the organisation of secondary education in Wales, and to advise how it may be consolidated and co-ordinated with a view to the establishment of a national system of public education in Wales, regard being had to the provisions of the Education Act, 1918, and to the recommendations of the Royal Commission on University Education in Wales. The members of the Committee are as follows:—The Hon. W. N. Bruce (chairman), Mr. W. R. Barker, Mr. J. N. Davies, Sir Owen Edwards, Miss M. L. Faithfull, Mr. William George, Mr. Thomas Griffiths, Miss E. P. Hughes, Prof. Ramsay Muir, the Rev. Prebendary Prosser, and the Rev. D. H. Williams. The secretary will be Mr. T. O. Roberts, to whom all communications on the subject should be addressed at the Board of Education, Victoria and Albert Museum, South Kensington, S.W.7.

THE Surveyors' Institution offers annually four scholarships, two of 80*l*. per annum and two of 50*l*., for intending land agents, valuers, building surveyors, municipal surveyors, etc. Each scholarship is tenable for three years at any university or affiliated college selected by the candidate successful in the competitive examination and approved by the council of the institution, subject to the scholar satisfying the authorities of his university or college in regard to progress and conduct. Each scholar, on election, must become a member of the university or college selected,

and must sign an agreement, with the concurrence of his parents or guardians if a minor, to enter the office of a surveyor approved by the council with the view of practising as a surveyor in the future, or as an alternative to engage in advanced research work in subjects approved by the council as of value to the profession, and in due course to sit for the intermediate and final examinations of the institution. Election to the scholarships will be by competitive examination conducted by the Oxford and Cambridge Joint Examination Board. In the examination candidates will be required to write an English essay chosen from four subjects set by the examiners and to present themselves for examination in either (a) language, (b) mathematics, or (c) science. If (a), not more than two of the following: Latin, Greek, French, German; if (b), mathematics only, or mathematics and one science subject; if (c), not more than two of the following: physics, chemistry, botany, physical geography, and elementary geology. The next examination will be held about the end of January. Entries should be addressed to the Secretary of the Surveyors' Institution, 12 Great George Street, Westminster, by December 15 next.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 26.—Sir J. J. Thomson, president, in the chair.—Dr. A. E. H. **Tutton**: Monoclinic double selenates of the cobalt group. This memoir deals with the four double selenates of the series $R_2M(SeO_4)_2.6H_2O$, in which M is cobalt and R is potassium, rubidium, cæsium, and ammonium. A complete crystallographic and physical investigation has been carried out on parallel lines to the work previously published concerning the magnesium, zinc, iron, and nickel groups, and to that concerning the complete analogous series of double sulphates. The results are in full accord with those derived from the previous investigations. Two dominant facts emerge, namely, (1) the progressive order of all the crystallographic and physical properties, following the progression of the atomic numbers (and therefore atomic weights) of the interchangeable alkali metals concerned, potassium, rubidium, and cæsium; and (2) the almost perfect isostructure—that is, congruency, coincidence, and equality of dimensions of the elementary cells of the monoclinic space-lattices—of the crystals of the ammonium and rubidium salts of the group. The progression with atomic number referred to under (1) is completely explained by the operation of Moseley's law, governing the progressive structural complexity of the atoms in accordance with the sequence of the atomic number.—Hertha **Ayrton**: A new method of driving off poisonous gases.—Dr. F. W. **Aston**: Experiments with perforated electrodes on the nature of the discharge in gases at low pressure. Experiments are described on the discharge between electrodes of a large flat form perforated with a long narrow slit, the charge passing through the slit being collected and measured in a Faraday cylinder. Direct measurements made with the Faraday cylinder behind the cathode and at the same potential seem to indicate that about half the total current in the discharge is brought up to the cathode by positive ions. Attempts to discover the distribution of velocities in this stream show that this is not directly determinable, owing to the very high ionisation in the region of the slit and other reasons, which are discussed. Using a perforated anode, it is found that as the distance from the cathode is increased arithmetically the current carried by the cathode rays into the Faraday cylinder decreases geometrically when the current is constant.—Mary **Seegar** and Prof. Karl **Pearson**: De Saint-Venant solution for the flexure of cantilevers of cross-section in the form of complete and curtate circular sectors; and the influence of the manner of fixing the built-in end of the cantilever on its deflection.—Dr. H. **Jeffreys**: The relation between wind and the distribution of pressure. A classification of some six hundred wind observations over the North Sea, according to their velocities and directions, showed that the most striking feature of the resulting values was their asymmetrical frequency distribution. From the fact that this was noticeable in nearly every class, it was inferred that it could be produced only by variation in turbulence or systematic contortion of the isobars, on a scale too small to be recorded on the weather map. The latter cause, however, and also such variations in turbulence as keep the coefficient of eddy viscosity the same at all heights, would lead to strong correlations between S/G and α, which are not observed. Hence it is concluded that the principal cause of variation in the relation of the surface wind to the gradient is variation in the vertical distribution of turbulence; and it is shown that such variation could give the effects actually observed.—Prof. C. H. **O'Donoghue**: The blood vascular system of the Tuatara, *Sphenodon punctatus*.—G. H. **Livens**: The fundamental formulations of electro-dynamics. The object aimed at in this paper is the removal of certain difficulties and discrepancies which exist in the usual formulations of electro-dynamic theory. After a brief statement of the differential theory in which a new equation,

$$\frac{dB}{dt}=\frac{dH}{dt}+4\pi\frac{dI}{dt}+4\pi\,\mathrm{Curl}\,[Iv],$$

is introduced to express the time-rate of change of the magnetic force H when the magnetic media are in motion with a velocity v, a general formulation of the theory based on the principle of least action is developed, in a manner which leads directly to expressions for the intrinsic energies of the polarised media, for the forces per unit volume on the polarised and charged media, and, finally, for the complete electro-motive force on the moving electrical elements.—Dr. A. E. **Oxley**: The influence of molecular constitution and temperature on magnetic susceptibility. Part iv.: Further applications of the molecular field. The main paper is a continuation of the work published in Royal Society Transactions, A, vols. ccxiv. (1914), and A, ccxv. (1915), and Royal Society Proceedings, A, vol. xcv. (1918). It deals with the additional applications of the local molecular forcive in crystalline and vitreous media. It is shown that the change of volume on crystallisation can be interpreted as a magneto-striction effect of the molecular field. The molecular field is assumed to be proportional to the local intensity of magnetisation, the coefficient of proportionality being the reciprocal of the limiting susceptibility under field strengths equal to the respective molecular fields at different temperatures. A discussion of the nature of the molecular field is given, and the conclusion is reached that the forces of crystallisation are of a magnetic nature. The large value of the local magnetic forcive suggests that they may play an important part in chemical combination, and further evidence is given for the existence of the magneton in diamagnetic media.—A. **Mallock**: Diffusion of light by rain, cloud, or fog. In this note attention is directed to the similarity between the diffusion of light by small drops and the diffusion of heat by conduction. The drops under consideration are supposed to have, at least, diameters of many wave-lengths of the light scattered by them, so that peculiarities of diffusion dependent on the relation of

diameter to wave-length do not affect the results. Rain, cloud, and fog are formed of such drops. The opacity of a space containing a number of drops insufficient completely to obliterate objects on the far side depends on the lowering of the contrast between light and shade brought about by the light scattered by them, and not on any blurring or lack of definition. The amount of direct light which reaches the eye from a source within a fog or shower is proportional to 2^{-m}, where ml is the distance of the source from the eye, and l is the thickness of the stratum which reduces the direct light by one-half. The reduction to one-half will be caused by such a number of drops as would, if placed side by side in a plane to which the ray is normal, cut off all the direct light; but when the same number of drops are distributed at random in a volume of thickness l in the direction of the ray, they allow half the direct light to pass, in consequence of the probability that some of them screen others, and thus leave space for direct radiation. A relation is shown between the rate of rainfall (1 in. per day = 1/86,000 in. per second) and the opacity of a shower.

Physical Society, June 13.—Prof. C. H. Lees, president, in the chair.—Dr. Balth. **van der Pol**, jun.: Comparison of the wave-form of the telephone current produced by a thermal detector and by a rectifier in heterodyne reception.—Profs. E. **Wilson** and E. F. **Herroun**: The magnetic properties of varieties of magnetite. The magnetic properties of certain varieties of magnetite as exhibited by crystallised, compact, or massive specimens and detached particles have been examined. In each case the susceptibility has been found to vary with the magnitude of the magnetising force after the manner of iron, the relative variation being much more pronounced in the case of those specimens having the higher susceptibility. The maximum susceptibility in the specimens examined occurs at a force ranging from 13 C.G.S. units in the crystal to 368, its magnitude varying from 3·12 to 0·127 C.G.S. units. The effect of heating has been greatly to increase susceptibility in some cases, and in others a negative effect has been produced. In the case of a specimen of Penryn magnetite, the large increase in the susceptibility was traced to the conversion of ferrous carbonate and ferric oxide into magnetite. Very high susceptibility in magnetite is never associated with high coercive force or retained magnetisation, the greatest values for the latter exhibited by specimens having an intermediate value of susceptibility of the order of 0·3 or 0·4. Lower susceptibility may be associated with high coercive force, but naturally the retained magnetisation is not very great, owing to the lower maximum of induced magnetisation.

Geological Society, June 25.—Mr. G. W. Lamplugh, president, in the chair.—A. E. **Kitson**: Outlines of the geology of Southern Nigeria (British West Africa), with especial reference to the Tertiary deposits. The oldest rocks in Southern Nigeria comprise a series of quartzites, schists of various kinds, blue and white marble, grey limestones, altered tuffs and lavas, amphibolites, and gneisses. They may be classed provisionally as pre-Cambrian. So far as they have been observed, there is a great hiatus between the pre-Cambrian and the next known sediments, the Upper Cretaceous. Normally, these are slightly inclined rocks. Flanking the Udi plateau on the south and south-east, and extending thence over the southern part of the great valley to the Cross River, is a series of Eocene estuarine shales, clays, and marls, with septarian nodules and pieces of coal and resin, and a rich fauna consisting principally of mollusca, but including fragmentary remains of whales, birds, fishes, and turtles. A thick series of sandstones, mudstones, shales, and seams of brown coal forms a large portion of the basin of the Niger, west of the Udi plateau. In the Ijebu Jebu district are bituminiferous sands and clays with Pliocene estuarine shells. Extending over practically the whole of the country south of lat. 7° 10′ N., and west of the great valley of the marine Cretaceous, is a varying thickness of (usually unstratified) clayey sands, probably late Pliocene—the Benin Sands series of Mr. J. Parkinson. Along the coast-line and extending for considerable distances up the Niger and Cross Rivers are fluviatile, deltaic, littoral, and swamp gravels, sands, and muds of Pleistocene and Recent age. In the Cross River basin, intruded into the marine Cretaceous, are volcanic necks of decomposed agglomerate, and sills (?) and dykes of olivine-dolerite. These are probably pre-Eocene. The Yorubaland crystalline rocks contain magnetite in considerable quantities, while these and the crystalline rocks of the Oban Hills show smaller quantities of cassiterite, gold, monazite, and columbite.—J. B. **Harrison** and C. B. W. **Anderson**: Notes on the extraneous minerals in the coral-limestones of Barbados. Characteristic representative specimens of the fossil reef-corals and of the beach-rock of the high-level and low-level limestone terraces of Barbados were examined chemically and microscopically in order to ascertain the composition, nature, and origin of their extraneous mineral contents. Chemical analyses of the residua were made, and the results of these and of the microscopical examinations are tabulated in the paper. The extraneous minerals present were found to be apparently fresh and largely unaltered fragments of wind-borne volcanic minerals and glass. It was found that the volcanic minerals enclosed in the reef-corals on which they fell have been protected from change; those in the clastic limestone or bed-rock show signs of detrition and weathering prior to the consolidation of the limestone. Similar minerals separated from clay normally formed and accumulated in a pothole in the limestone supply evidence of weathering changes after being set free from the rock. It is shown that the composition of the sedentary residual soils on the higher limestone-terraces of Barbados corresponds in its essential parts with the residua separated, either naturally or artificially, from the limestone. The proportions of magnesium carbonate present in the coral-rock are briefly discussed, and complete analyses of the high-level and the low-level limestones are given.

DUBLIN.

Royal Irish Academy, June 23.—The Most Rev. J. H. Bernard, president, in the chair.—A. **Henry** and Miss M. G. **Flood**: The history of the Dunkeld hybrid larch, *Larix eurolepis*. This tree is raised in large quantities from the seed of ten Japanese larches (*L. leptolepis*) growing at Dunkeld in the vicinity of numerous European larches (*L. europaea*), from which pollen is wafted by the wind. The seedlings are intermediate between the two parents, as shown by microscopical examination of the sections of the leaves, by the colour and form of the bracts and scales of the cones, and by the colour of the twigs, leaves, etc. The hybrid seedlings, of which more than 100 acres have been planted on the Dunkeld, Athol, and Murthly estates, are very vigorous. Attention is directed to the function of the papillæ on the surface of the leaf, which are constant in *L. leptolepis*, absent in *L. europaea*, and only present on a few cells in the case of the hybrid. Reference is also made to other hybrid conifers, including *L. marschlinsii*, Coaz, which has recently appeared in Switzerland; *L. pen-*

dula, Salisbury; and *Tsuga jeffreyi*, A. Henry. The last is a peculiar hemlock spruce, originally raised at Edinburgh in 1851 from seeds collected by Jeffrey. It has recently appeared again at Cowichan Lake, Vancouver Island, from which locality a single plant has been sent to Knapton, Abbeyleix, Ireland.

CALCUTTA.

Asiatic Society of Bengal, June 4.—N. **Nath Sen**: Interaction of phosphorus halides and arsenious and arsenic compounds.—H. H. **Haines**: Some new species of plants from Bihar and Orissa.—H. C. **Das-Gupta**: Notes on the Panchet reptile. In part i. a few bones of the celebrated Panchet reptile obtained from the neighbourhood of Asansol are described, and in part ii. the question of the systematic position of the reptile is reviewed, as of late doubts have been raised regarding its Dicynodont nature. An examination of all the materials available shows the author that though, without the discovery of an entire skull, the zoological position of the Panchet reptile cannot be definitely settled, there is no reasonable ground to suppose that Lydekker was mistaken when he placed the Panchet reptile under his new generic name Ptychosiagum = Ptychognathus, Owen. The only other genus with which some of the Panchet bones agree is Oudenodon, but the presence of tusks shows that it cannot be assigned to that genus.—H. C. **Das-Gupta**: Note on a mammalian fossil from Bhavanagar (Kathiawar). In this paper the author has described a mammalian humerus obtained at Hathab. The fossil is fragmentary, and no generic determination is possible. It is, however, interesting as being the first record of a Gáj mammal obtained in Kathiawar.

BOOKS RECEIVED.

A Comparative Study of the Bantu and Semi-Bantu Languages. By Sir H. H. Johnston. Pp. xi+815. (Oxford: At the Clarendon Press, 1919.) 3*l*. 3*s*. net.

Eugenics and Environment. By Prof. C. L. Morgan. Pp. 82. (London: John Bale, Sons, and Danielsson, Ltd., 1919.) 2*s*. net.

The Problem of Sex Diseases. By Major A. Corbett-Smith. Second edition. Pp. xv+107. (London: John Bale, Sons, and Danielsson, Ltd., 1919.) 2*s*. 6*d*. net.

Salt and the Salt Industry. By A. F. Calvert. (Pitman's Common Commodities and Industries Series.) Pp. vii+151. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 2*s*. 6*d*. net.

The Return to Oxford: A Memorial Lay. By W. Garstang. Pp. 14. (Oxford: B. H. Blackwell, 1919.) 1*s*. net.

The Mechanism of Evolution in Leptinotarsa. By W. L. Tower. (Publication No. 263 of the Carnegie Institution of Washington.) Pp. viii+384+19 plates. (Washington: Carnegie Institution, 1918.)

History of the Theory of Numbers. Vol. i., Divisibility and Primality. By Prof. L. E. Dickson. (Publication No. 256 of the Carnegie Institution of Washington.) Pp. xii+486. (Washington: Carnegie Institution, 1919.)

The Adolfo Stahl Lectures in Astronomy. Delivered in San Francisco, California, in 1916–17 and 1917–18, under the auspices of the Astronomical Society of the Pacific. Pp. xiv+257+liii plates. (San Francisco: Astronomical Society of the Pacific.) 2.75 dollars.

Problèmes Scientifiques d'Alimentation en France pendant la Guerre. Bibliographie Analytique des Travaux Français publiés pendant la Guerre (1914–18). Par R. Legendre. Pp. 160. (Paris: Masson et Cie, 1919.) 6 francs net.

Number Stories of Long Ago. By Prof. D. E. Smith. Pp. vii+136. (Boston, Mass., and London: Ginn and Co., 1919.) 2*s*. 3*d*. net.

Number Puzzles before the Log Fire: Being those Given in the "Number Stories of Long Ago." By Prof. D. E. Smith. Pp. iv+14. (Boston, Mass., and London: Ginn and Co., 1919.) 6*d*. net.

Board of Agriculture and Fisheries. Guides to Smallholders. No. 3: Co-operation for Small Producers. Pp. 15. (London: Secretary of Board, 3 St. James's Square, London, S.W.1, 1919.) 2*d*.

Board of Scientific Advice for India. Annual Report for the Year 1917–18. (Calcutta: Superintendent, Government Printing, India, 1919.) 14 annas, or 1*s*. 3*d*.

DIARY OF SOCIETIES.

THURSDAY, JULY 17.

SOCIETY OF CHEMICAL INDUSTRY (at the Salters' Hall, St. Swithin's Lane, E.C.), at 10.30 a.m.–1 p.m., and 3–5 p.m.—Conference on Dye Stuffs, Synthetic Drugs, and Associated Products. Dr. Herbert Levinstein: Progress in the British Dyestuff Industry.—James Morton: Dyestuffs and British Textiles.—Prof. G. T. Morgan: Certain Colour-producing Intermediates.—E. V. Evans: The Manufacture of Intermediates.—F. H. Carr: The Manufacture of Synthetic Drugs.—Dr. W. R. Innes: Photographic Chemicals.—Dr. M. O. Forster: The Organised Preparation of Laboratory Chemicals.—At the Goldsmiths' Hall, Foster Lane, E.C., at 10.30 a.m.–1 p.m.—Conference on the Chrome Tanning Industry. Prof. D. McCandlish: The Development of the Chrome Tanning Industry in the United States of America.—M. C. Lamb: The Progress of the Chrome Tanning Industry in Great Britain.—Dr. Gordon Parker: The War Services of the Chrome Tanning Industry.—At 3–5 p.m.—Conference on Recent Developments in the Fermentation Industries. Sir Frederick Nathan: The Manufacture of Acetone.—Amos Gill: The Acetone Fermentation Process and its Technical Applications.—A. Chaston Chapman: The Employment of Micro-organisms in the Service of Chemical Industry—A Plea for a National Institute of Micro-biology.

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THURSDAY, JULY 24, 1919.

A GUIDE TO LENS CALCULATIONS.

Applied Optics: The Computation of Optical Systems. Being the "Handbuch der angewandten Optik" of Dr. Adolph Steinheil and Dr. Ernest Voit. Translated and edited by James Weir French. Vol. ii. Pp. vi+207+v plates. (London: Blackie and Son, Ltd., 1919.) Price 12s. 6d. net.

THE introductory section of this volume[1] contains an explanation of the symbols employed and of the sign conventions adopted, together with extensive tables of formulæ designed to cover the trigonometrical calculation of rays through a series of centred refracting surfaces. The system described is probably far more extensively employed than any other by practical opticians. It is constructed throughout with a view to convenience in logarithmic computation, and only minor improvements have been effected since it was first published. Its popularity has not been seriously affected by the introduction of the calculating machine into the workshop.

After a chapter on the measurement of refractive indices and the calculation of achromatic prisms come three chapters on achromatic doublet objectives, which include fully worked examples of the application of the formulæ given earlier. The authors set out to record their experience in designing optical systems, and to this end have tabulated the results obtained with series of objectives corrected for spherical and chromatic aberrations. They have not indicated which zone of the objectives should be corrected to yield the most satisfactory performance, nor the maximum amount of the aberrations present for uncorrected zones, but, owing to the care with which the objectives have been calculated, the results given are of sufficient value to ensure for the book a place on the reference shelf of the optical computer. In finding the forms for the lenses the authors have been guided by a number of principles derived from the calculation of rays through a series of single lenses (see vol. i.). Of these, that relating to the influence of the lens form on spherical aberration may be singled out as of paramount importance in designing doublet objectives. The principle states that the spherical aberration of a single lens is a minimum when the deviation of a ray is divided equally between the two surfaces, and subsequent developments show that this is regarded as an exact law rather than as a rough approximation. This conclusion is decidedly surprising, as the spherical aberration has previously been found to be less when the deviation is divided in the ratio 3 : 2 than when it is equally divided. It is not difficult to prove that, for minimum aberration, the deviation at the first surface must be greater or less than that at the second according as the dimensions of the object are greater or less than those of the image. The extent of the difference involves the refractive index as well as the magnification, and cases may easily arise in which the supposed law leads to serious errors. The forms given for the lenses with flattest possible flint components are incorrect, owing to this error of principle.

It may be noted that some conclusions which were correct at the time the book was written do not necessarily apply if types of glass produced within the last thirty years are employed.

The original German edition was not free from a number of important errors, and most of these are present in this translation. In a second edition the formulæ should be carefully revised, and errors in the constructional data of the objectives corrected by recalculation. The original text is not always adhered to, and the new definition for the sign of the deviation gives the wrong result for a ray below the axis. The awkward $\pm$ sign, which occurred frequently in the original, has generally been avoided. Changes have been made in the symbols, but π is retained as a variable angle. The table of differences between arcs and sines, intended for use in removing small residuals of spherical aberration, has been omitted. The appendices by Steinheil and Seidel on the determination of the best mean dispersion ratio, and by Seidel on the derivation of the formulæ for tracing a general ray, have been included in this volume.

The translator has written a clear English text. The book is very well printed, and the thickness of the paper will be appreciated by those who require to refer to it frequently. One of the most serious omissions of the original has been remedied by the inclusion of a very complete index. No pains have been spared to make the volume worthy of the position it is intended to take as a standard book of reference for the optical computer.

T. S.

[1] A review of the first volume was published in NATURE, September 26, 1918, vol. cii., p. 61.

COLLOID-CHEMISTRY.

A Handbook of Colloid-Chemistry. The Recognition of Colloids, the Theory of Colloids, and their General Physico-Chemical Properties. By Dr. Wolfgang Ostwald. Second English edition, translated from the third German edition by Prof. Martin H. Fischer. With numerous notes added by Emil Hatschek. Pp. xvi+284. (London: J. and A. Churchill, 1919.) Price 15s. net.

THE increasing recognition of the importance of a study of colloidal matter, both for physical theory and for industrial practice, has led to a growing demand for text-books dealing specially with this branch of science. Hitherto this demand has been chiefly met by works in the German language or by translations of these, and of such works the one before us has for a number of years occupied a foremost place. This, doubtless, is due in no small measure to the marked activity of the author both as an investigator and as

editor of the *Kolloid-Zeitschrift*. Wolfgang Ostwald possesses in no small degree the literary facility of his father; and although this facility leads sometimes to an over-wordiness of expression, the author has had considerable success in directing the attention of wide circles of workers to the importance of the study of colloids.

Although the third German edition, from which the first English translation was made, was published in 1912, the translation was not published until 1915. It will be understood, therefore, that the publishers and translator were placed in a position of some difficulty when they had to meet the demand for a new edition of the English version of the work. To issue merely a reprint would have meant the continuance for some years of a book which at the time of its first appearance was already somewhat out of date; and to obtain a revision of the book by the author was impossible owing to the existence of a state of war. A compromise was therefore adopted, the co-operation of Mr. E. Hatschek was obtained, and an attempt was made to revise and bring up to date the original translation. The translators have sought to meet the situation "by leaving entirely untouched those large portions of the volume which contain the author's individual views, to correct errors in quotation and in mathematical formulæ, and to add" (by the pen of Mr. Hatschek) "numerous paragraphs intended to bring to the reader various important advances in colloid-chemistry which have been made since 1912, especially such as have to do with the mechanical properties of colloids, more particularly their viscosity." The reviewer must confess that he is not impressed by the success of the attempted revision.

It is to be regretted, in the first place, that the translators have not indicated more clearly the additions which have been made, but it would appear, from such comparison with the first edition as the reviewer has been able to carry out, that the additions are confined, essentially, to two sections on "Rate of Shear and Viscosity of Emulsoids" and "Theory of Viscosity of Emulsoids." These two sections, by an active worker in this domain, are valuable and have been satisfactorily incorporated in the work. Sentences have also been added here and there, but the book, as a whole, can scarcely claim to be up to date; and it is to be regretted that the translators did not seek more fully a way out of their difficulties by more numerous footnote references to the recent literature. Apart from those in the new sections added by Mr. Hatschek, the reviewer has noticed only about half a dozen references to literature published since the date of the first edition. The translation has, in several particulars, been improved. "Dispersion medium," for example, has been substituted for "dispersion means," but it seems a pity to retain the expression "internal friction" for "viscosity," and a still greater pity to make use of both terms in a somewhat haphazard manner. "Molecular kinetic" could, with advantage, be everywhere substituted for "moleculo-kinetic," and experimental "results" would be more pleasing, to an English ear at least, than experimental "findings."

Apart from the criticism which has been offered, the book is a very useful one both for the specialist student of colloids and for the large number of workers in the various domains of science and industry in which colloids are now recognised as playing an important part. A survey of the more important features of colloid-chemistry is here presented in an interesting and readable, although sometimes rather too diffuse, form; and the book furnishes a good introduction to a more detailed and special study of the subject. The work does not, however, claim to be exhaustive, and the translators, by rendering "Grundriss" as "Handbook," give a somewhat false idea of the scope of the book. A. F.

PHYSIOLOGY FOR STUDENTS AND PRACTITIONERS.

A Text-book of Physiology. By Dr. Martin Flack and Dr. Leonard Hill. Pp. viii + 800. (London: Edward Arnold, 1919.) Price 25*s*. net.

THE authors of this text-book deserve hearty congratulations on having treated the subject in a somewhat unorthodox way which is decidedly interesting. Whether the work will appeal to the rather whimsical tastes of the medical student or teacher remains to be seen, since, on one hand, it may be regarded as departing, in certain respects, too much from the beaten track of examination requirements, and, on the other, cannot by any means be regarded as a cram-book for rapid revision. It is, nevertheless, written expressly for the use of medical students and practitioners, to the latter of whom it should appeal strongly.

The authors, as teachers of long experience and wide repute, have a right to record their general attitude to the subject in the form of a text-book, but it is almost certain that many teachers will disagree with them regarding the balance of the various sections of the work. Among the best features of the book are the clearness of the tables and schemes, and the great wealth of illustrative detail drawn from the most varied sources (pp. 500, 633, 771, for instance). The chemical parts are treated with brevity, and contain some statements that will not be generally accepted. Thus (p. 31) colloids are said to exert no osmotic pressure; again (p. 85), it is questioned whether amino-acids are normal constituents of blood plasma; on p. 93 the chemistry of formation of methæmoglobin is unorthodox.

One of the most fully treated sections is that dealing with the circulation; there are, however, some errors in this portion—for instance, in the description of the heart-lung preparation and in

the account of the cardiometer (Fig. 68); it is also unfortunate that reference is not made to the term "premature contraction" as an alternative to "extra systole," as the latter is objected to by some authorities. These small points are chosen as illustrating the kind of thing which can be readily altered in subsequent editions. The question of the general balance of the book is largely a matter of opinion, and probably no two readers will agree as to the chapters which might be considered as inadequately treated; to the present reviewer those on the central nervous system, the kidney, and the physiology of muscle and nerve appear to require expansion. Histological considerations are omitted, no doubt in order to save space, but, nevertheless, there are a large number of illustrations; some of these (52, 53, 336, 391–393, 399, 400) might perhaps have been omitted without much loss, though the excellence of the illustrations is one of the strong features of the book; few of them are likely to be familiar to students from perusal of other text-books.

The book should be much appreciated by advanced students on account of the treatment of some of the sections in a manner new to students' books, and by elementary students owing to the interesting manner in which the subject is treated.

OUR BOOKSHELF.

Biochemical Catalysts in Life and Industry. Proteolytic Enzymes. By Prof. Jean Effront. Translated by Prof. Samuel C. Prescott, assisted by Charles S. Venable. Pp. xi+752. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 23*s.* net.

THE name "biochemical catalysts" is used by the author as an alternative for the more usual name of "enzymes," and has the advantage of calling to mind the fact that these are only a particular class of catalysts. The present work is devoted to those enzymes which act on proteins and their degradation products. It includes also a discussion of the phenomena of immunity, as well as of the processes of coagulation of the blood and milk, processes with regard to which some doubt may be felt as to their being catalytic. Urease is also described.

An excellent and complete account of the subject is given up to the date of the original French work, which appears to be not later than 1912. It is somewhat unfortunate that the translator has not added supplementary notes to bring the book up to date, an addition that would have much increased its value. Indeed, some may be inclined to wonder why the mere translation of the original book was considered necessary. All readers interested should be able to read the French edition. The date of the original work doubtless accounts for some statements which are no longer correct. For example, it is said that enzymes are proteins, and the existence of true anti-bodies to enzymes is accepted. In this connection it may be mentioned that British and American work is rather meagrely referred to. On the whole, however, the book will be found a useful one, especially in that part dealing with those industrial processes in which proteolytic enzymes play an important part. Such are brewing, cheese- and bread-making, tanning, and their use in therapeutics. The fixation of nitrogen by the soil and the question of the value of amino-acids as exclusive nitrogen food for animals are discussed in some detail.

An interesting introductory section will be found. We may note that the author is inclined to favour the theory of surface action rather than that of the formation of intermediate compounds of a chemical nature. W. M. B.

Formulaire de l'Electricien et du Mécanicien. By Hospitalier et Roux. Vingt-neuvième édition (1919). By Gaston Roux. Pp. 11+1485. (Paris: Masson et Cie, 1919.) Price 20 francs.

THE older generation of electricians are well acquainted with the earlier editions of this work; and much of our standard nomenclature, as well as many of the symbols in everyday use, is due to Hospitalier. Nowadays numerous other pocket-books partially fulfil the functions of a book of reference for electricians, but not any of them are so complete or so well arranged as this book. We are inclined to grumble at its size—it contains now nearly 1500 pages—but it is difficult to find anything that might be cut out with advantage, and there are many subjects, like wireless telegraphy and telephony, which one would like to see included.

The first 500 pages are on purely academic subjects—mathematics, physics, dynamics, etc.—and enable the engineer to refresh his memory of his college studies. The next 600 pages are on electro-technical subjects, and the remainder of the book contains French official documents, a comparison of which with our own Board of Trade regulations is very instructive. A complete index is given.

In several places theorems have been abbreviated in order to save space, with unfortunate results. For instance, the theorems on the design of networks are almost unintelligible. On p. 856 we cannot understand what Santarelli's theorem is. In the first theorem by Bochet there is a fairly obvious misprint in the final formula. In the second it is not stated what condition the conductors have to fulfil in order that their mass may be a minimum; the formulæ given, therefore, may well be misleading. From the 1909 edition we find that the condition they must satisfy is that the sum of the voltage drops is constant. This is quite unpractical. The real condition is that the power expended in them should be a minimum when the maximum voltage drop is fixed. The solution of this problem does not agree with that given on p. 857. A. R.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Research and Service.

THERE appeared in NATURE for February 13 last a criticism from the pen of Prof. F. Soddy of an attitude expressed by me in my book entitled "The Twin Ideals." As there seems to be some possibility of misunderstanding, owing to the form of the work, may I briefly express the position I endeavoured to indicate? Those who indulge in the monastic attitude, who withdraw from the world and prosecute research of a recondite character, are outside reasonable criticism provided the work is done at their own expense. If, however, this work is to be supported from public funds, justification is necessary, and the justification has appeared to me to be twofold. In the first place, few people have the inclination or capacity for research, and it is therefore an attitude that should be encouraged. In the second place, practical discoveries of value are at times made incidentally to research of the kind. It appears to me, however, that much damage is done by the assumption on the part of such researchers that their efforts are the only line of research worth considering. I have never been able to satisfy myself that research conducted with a definitely practical end in view would not be equal to, if not more valuable than, the monastic form. I have, therefore, simply asked that in their attitude to the world at large those who prefer the life of the scientific recluse should recognise the equal value of the work of those whose inclinations take them in a practical direction, and that they should not seek to divert bright young intelligences into their own channel of activities when they tend to develop in the opposite direction.

Furthermore, there seems to me to be a moral obligation on all men of science to take practical steps for the diffusion of the knowledge gained, so that anything of practical value may be utilised by humanity in general. It has seemed to me that the monastic habit in researchers, together with indifference to the immediate requirements of the world and with the disposition to regard their own set of activities as paramount, is apt to produce results that are beneficial neither to the individuals concerned nor to the nation.

JAMES W. BARRETT.

SIR JAMES BARRETT reiterates in his letter the views he has expressed in his book "The Twin Ideals," which I reviewed in NATURE, but I fail to see how they have been or can be misunderstood. He says that at times practical discoveries of value are made incidentally to researches pursued for their own sake, apart from practical ends, and that such investigators assume their efforts to be the only kind of research worth considering. It would be more generally agreed, I think, that all the great practical advances of the present scientific era owe their origin to purely theoretical investigations pursued for their own sake, and that such work is as different from the pursuit of practical discoveries of value as scientific exploration is from prospecting for gold, minerals, or specific commodities. To ask whether researches conducted with a definite practical end are not equal, if not superior, to those concerned with the advancement of the boundaries of knowledge seems like asking whether the fruit of a tree is not of equal or superior value to its root. To suggest that those pursuing researches of a recondite and academic character, who find it necessary for their work to withdraw largely from the practical world of affairs and politics, are only outside reasonable criticism if their work is pursued at their own expense seems as unreasonable as to deny nourishment to the roots of a tree because of their recluseness, their indifference to the immediate requirements of the world and inability to survive being hauled out into it.

FREDERICK SODDY.

Wild Birds and Distasteful Insect Larvæ.

IN the literature on mimicry and protective colouring, many writers have claimed that both the larva and imago of the currant moth (*Abraxas grossulariata*, Steph.) are protected by colouring and an acrid flavour, in consequence of which they are usually rejected by wild birds. That the larvæ of certain moths are distasteful to birds has been proved by actual experiment, but I have considerable doubts as to the inclusion of the currant moth in this category.

In my work on the food of wild birds I have found the imagines, and more often the larvæ, of Abraxas in the stomach of the song thrush, missel thrush, blackbird, great tit, whitethroat, house sparrow, yellow bunting, and cuckoo; and in 1918 large numbers of the larvæ were found in the stomachs of the song thrush and missel thrush over a period of seven consecutive days.

In the case of the song thrush, the parent birds were observed collecting these larvæ during the first five or six days after the young were hatched, and were seen to bring the same to the nest, where they were readily devoured by the young birds. Indeed, a very large proportion of the food fed to the nestlings during this period consisted of the larvæ of Abraxas. Then the parent birds suddenly ceased to feed upon them.

Knowing that the supply was by no means exhausted, the currant bushes were examined and numerous larvæ observed. Forty-one specimens were collected and placed on fresh leaves in large glass dishes, but not one of the larvæ reached the pupa stage. From this collection we hatched out fourteen masses of cocoons of Microgaster and twenty-seven specimens of Exorista.

Although the currant bushes were very badly infested with the larvæ, we failed to find any pupæ in the soil beneath them, although it was collected and most carefully searched; moreover, during the present season not a single larva of Abraxas has been found on these bushes, and there must have been thousands of them during 1918.

Here, I think, we have an explanation of why the thrushes ceased to feed upon the larvæ, viz. because they were parasitised, and also an excellent example of two natural agencies—wild birds and insect parasites—practically exterminating what would undoubtedly have been a plague this year.

It is well known that the larvæ of Abraxas are frequently parasitised by the two above-mentioned insects. Is it not possible that the parasitised larvæ alone are rejected by wild birds, and only the non-parasitised specimens fed from?

WALTER E. COLLINGE.

The University, St. Andrews.

Science and Salaries.

THE issue of NATURE for July 11 contains a large number of advertisements of vacant posts of which details as to salary are stated in seventy-five cases. A few advertisements, which have been omitted from the following calculation, made no mention of salary.

Of the seventy-five, some said nothing about annual increment, a few gave the initial salary only, several gave both initial and maximum salaries, and some sufficient data to find the true average value of the salary over a number of years. This information has been used to deduce reasonable estimates of the prospects of advancement in other cases where the full data were wanting.

The posts were classified into three divisions, which comprised, roughly, (A) professorships, (B) lectureships, and (C) demonstratorships, or the equivalent of these, though of necessity a certain amount of discretion was used in the process. The average of the mean (not the minimum) salary in each class was then found, with the following result:—

Class	Number of vacancies	Average of mean salary £
A	16	620
B	22	385
C	37	234

The posts of the first class were nearly all at fixed salaries; those of the second started at, roughly, 320*l.*, rising to 450*l.*, per annum; those of the third went from an initial salary of about 200*l.* to 270*l.* These salaries probably give a fair idea of the value placed by governing bodies on the trained brain at the present day. They are undoubtedly higher than would have been the case in pre-war conditions, at least in the lower and middle of the two classes; but if the best brain-power of the nation is to receive full encouragement—and if labour difficulties are to disappear, production increase, and British civilisation advance, this can come only from full encouragement—these salaries are still far from adequate. Money has to-day little, if any, more than 45 per cent. of its purchasing power previous to the war. Salaries of 200*l.* and 600*l.* to-day bring their possessors no greater shares of economic goods than 90*l.* and 270*l.* in 1914.

It is beginning to be recognised—it is already recognised in the United States—that the elevation of the general level of prices is now more or less permanent, and that a return to a lower level, at least in this generation, is improbable, even if it should be desirable. The class of manual labourers has had its wages increased almost, if not quite, in proportion to the rise in prices. The mercantile community, working as it does on percentage margins, has made ordinary profits commensurate with that rise, and, in addition, has obtained unearned profits resulting from the rise itself. The class of fixed salary earners, which comprises the brain-workers of the nation, the professional class, has borne the brunt of the rising prices without anything like an adjustment of salary corresponding with the rise. It is the hardest hit of all by the war, and yet this class, perhaps more than any other, has contributed to winning the war. Hitherto patriotism has kept it silent. Now, however, the time has come when the scale of the professional man's salary must be revised. Incomes such as those found above do not admit of the upbringing and education of a family as befits its inherited ability; of the expenses inevitable if a man is to keep abreast of his profession; and of saving and insurance against sickness, age, and death.

"In war-time," writes the *Economist* of July 12, in a "business note" on British and German science, "we make full use of our men of science. If we did so in peace they might be as useful for production as they have been for destruction." The first step is to see that they get what, for them, is a living salary, else there will be no men of science to use. The second step is to see that their teachers get adequate remuneration, else there will be no training to make men of science of them. C.

MODERN SINGLE-OBSERVER RANGE-FINDERS.

THIRTY years ago the War Office asked for a rangefinder for field service that would measure ranges to within 4 per cent. at 1000 yards—that is, 40 yards at 1000 yards, or 160 yards at 2000 yards. A single-observer rangefinder of 30 in. base was designed to fulfil these requirements. In 1892 a naval rangefinder was required that would work within an error of 3 per cent. at 3000 yards, which is equivalent to 1 per cent. at 1000 yards. This demand was met by a rangefinder of 4 ft. 6 in. base. Whereas in 1895 the effective range of naval gunnery was between 2000 and 3000 yards, the effective range in 1904 was 6000 yards. For this service a rangefinder of 9 ft. base was introduced.

At the Battle of Jutland in 1916, firing commenced at a range of more than 20,000 yards, and although the makers had already constructed rangefinders of 15 ft. to 35 ft. base, the majority of the Service rangefinders were still of 9 ft. base, the Fifth Battle Squadron alone having been equipped with 15 ft. base rangefinders capable of measuring a range of 20,000 yards to within 170 yards, an error equivalent to 18 in. at 1000 yards. The 30 ft. base rangefinders exhibited by Messrs. Barr and Stroud, Ltd., at their stand at the British Scientific Products Exhibition are designed to work within half this error (Fig. 1).

Thus in the development of single-observer rangefinders during the past thirty years, the uncertainty of observation has been reduced from 40 yards at 1000 yards to the equivalent of 9 in. at 1000 yards; that is, the accuracy has been increased 160-fold.

This increase of accuracy has been obtained by increasing the base length about 12-fold and the magnification about 3-fold, thus accounting for a 36-fold increase. The remainder of the increase has been attained by refinements in the design and construction of the optical and mechanical elements based upon the results of research work conducted continuously during many years by a large staff of scientifically trained observers.

The accuracy of observation when using a coincidence rangefinder is ultimately dependent upon the accuracy with which the eye can detect a want of alignment between the partial images of the object in the field of view, and this largely depends upon the manner in which the images are presented for observation. As a result of much experience and many experiments on the alignment of images as presented in the Barr and Stroud rangefinders, it would appear that, under ordinary good conditions of observation, a want of alignment between the images can be detected when they subtend at the eye an angle of about 12 secs., *i.e.* 0·0000582 in circular measure, although frequently a much smaller angle can be resolved.

If B is the base of the rangefinder, M the magnifying power, and R the range, then

$$\delta R = 0{\cdot}0000582\, R^2/MB.$$

From this formula it will be seen that, to decrease the error δR at a particular range, either the magnification M or the base length B must be increased. In practice the magnification is limited by the permissible size of the optical parts and the necessity to provide for range-taking in dull light, by the quality of the optical glass, and by external circumstances such as mirage due to the intervening atmosphere. At the present time a magnification of more than 30 diameters is not desirable. When this maximum magnification is provided, the required accuracy of observation is then obtained by increasing the base length.

At the commencement of the war no British battleship carried a rangefinder of greater base than 9 ft. This base had been decided upon in 1904, when the maximum effective range for the opening of fire was generally assumed to be not greater than about 6000 yards. In the Battle of Jutland fire was carried out at ranges above 20,000 yards. The *Iron Duke,* which carried only 9 ft. rangefinders, opened fire at 12,000 yards. The rangefinders were, therefore, called upon to perform a duty at least four times as onerous as that for which they were originally designed. It will be understood that the substitution on existing ships of the larger types of rangefinders available involved extensive structural alterations that could not readily be carried out, and it is only within very recent years that the importance of rangefinding has been recognised as being sufficient to justify the ships being designed for the accommodation of rangefinders most suitable for the guns.

Notwithstanding the use of 9 ft. rangefinders in association with guns, the power of which has been so greatly developed during the last twelve years, the British Fleet at the Battle of Jutland defeated the German ships, which there is good reason to believe were equipped with rangefinders of 20 ft. base and, probably, to some extent 33 ft. base. In such circumstances it is not surprising that the German rangefinding was excellent: it is more surprising that it was not very much better and that its excellence was confined to the first stage of the action.

It should be observed that, for a given gun, the longer the range the more necessary it is to know the range accurately, on account of the greater angle of descent of the projectile—that is to say, an error of 100 yards in range has a much greater effect on the percentage of hits at 24,000 yards than at 6000 yards—but a rangefinder gives errors varying according to the square of the distance. The problem of finding a range of 24,000 yards within 100 yards is sixteen times as difficult as the finding of a range of 6000 yards within the same limit.

The modern rangefinder differs from the earlier types in the size of the optical parts and, consequently, of the mechanical parts, and in the provision of internal adjusting devices and of such accessories as variable power eye-pieces, light-filters, and apparatus involving complicated conical gearing for the conversion of the reciprocal scale into a uniform scale of ranges. Considerable improvements have been effected in the mountings, which are necessarily designed to suit particular

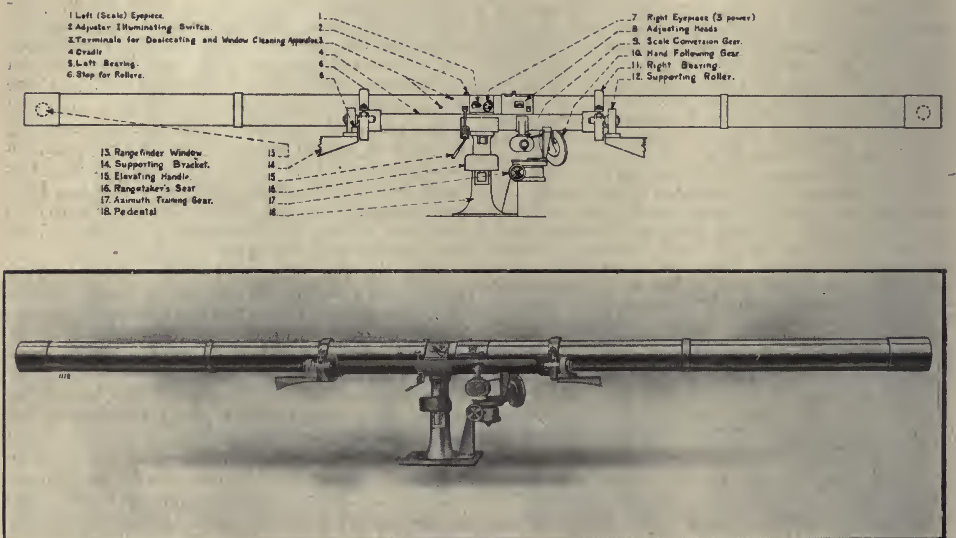

Fig. 1.—Naval rangefinder type F.X. with uniform range scale accessories. Base length 30 ft.; Magnifications 16, 20, and 28; uncertainty of observation under good conditions 330 yards at 40,000 yards range.

requirements and the structural arrangements of the ships. Provision is now generally made for three operators, namely, the rangetaker, who also controls the rangefinder in elevation; the trainer, who is provided with a special sighting periscope; and the scale reader, who transmits the ranges to the fire control station.

The advent of aerial craft has necessitated the use of special combined range and height finders which automatically determine the height of the target from its range and elevation. In the case of naval anti-aircraft instruments, the vertical from which the elevation is reckoned is defined by means of a damped pendulum device. Anti-aircraft height finders for land purposes have the advantage of a steady platform, and in some respects the problem is simpler, as the horizontal can then be determined with sufficient accuracy by means of a good spirit level provided upon the mounting.

Whereas the range of an approaching aeroplane changes so rapidly as to make the operation of maintaining the coincidence of the partial images in the field of view of a rangefinder a matter of some difficulty, the height of the aeroplane remains comparatively constant for considerable periods. It is generally more convenient, therefore, to measure the height, from which the setting of the gun can be readily adjusted in relation to a suitably engraved gunsight scale. As the range is a function of the elevation when the height is constant, an arrangement has been devised whereby the partial images of the moving aerial target are kept in coincidence by the simple operation of following the target. For this purpose, the elevating gear is arranged to act upon the deflecting prism of the rangefinder through the intermediary of conical spiral gears, which are equivalent to cams of the requisite form. If the height alters, the partial images can be brought again into coincidence by independent direct operation of the working head. Both heights and ranges are indicated by the instrument, the latter being better suited to gunnery purposes when the aircraft appears at a long distance over the horizon.

The problem of hitting enemy aircraft at long ranges is greatly complicated by the necessity of taking account not only of the interval that must elapse between the finding of the range (or height) and the setting of this upon the gun-sights and the laying of the guns, but also of the greater interval between the time of firing of the gun and the arrival of the shot at its destination. The gun has to be sighted and laid, not for the ascertained position of the target, but for the position that it may be expected to occupy after an interval, it may be of thirty seconds or more, during which time the target may have travelled 1000 or even 2000 yards from the position that had been determined. The new and difficult problems thereby involved have already been solved, more or less completely, by the invention of predicting instruments closely associated with the range and height finders.

JAMES WEIR FRENCH.

THE BOURNEMOUTH MEETING OF THE BRITISH ASSOCIATION.

THE eighty-seventh meeting of the British Association for the Advancement of Science will this year be held at Bournemouth, under the presidency of the Hon. Sir Charles A. Parsons, K.C.B., F.R.S., on September 9–13. The last meeting was held at Newcastle-upon-Tyne in 1916, the 1917 and 1918 assemblies having been abandoned owing to obstacles brought about by the war. This was the first break in the annual meetings of the Association since its inception in 1831. With the return of peace and happier conditions, it is anticipated that the Bournemouth meeting will be a successful and memorable one.

A strong local executive committee, with the Mayor as chairman, has been energetically at work for some months. The preliminary arrangements are well advanced, and every effort is being made to ensure the complete success of the meeting. So far as organisation is concerned, nothing is likely to be lacking, and it only remains for those interested or engaged in scientific work to take full advantage of the opportunities offered to them. Already the number of applications for election as annual members and associates is considerable, and doubtless as the date of the meeting approaches it will increase rapidly.

The Association will find a home in the Municipal College, a fine building, centrally situated, which was erected shortly before the war. Practically the whole of the college rooms will be placed at the disposal of the Association for the week, and will afford ample and conveniently centralised accommodation for its many and varied activities. Only the large public assemblies —the inaugural general meeting, at which the president's address is delivered; the discourses by Sir Arthur Evans, F.R.S., and Mr. Sidney G. Brown, F.R.S.; and the usual conversazione— will be held elsewhere. The Winter Gardens Pavilion, which is capable of seating an audience of upwards of 1200, will be the scene of these functions.

The programme of work is very full, and the week will be one of great activity. For the serious worker there will, as always, be many interesting papers and discussions, while the rumour that hitherto carefully guarded secrets of the work of men of science in the war will be made known for the first time is sufficient to appeal to the imagination of the general public and to focus attention upon the meeting.

Social functions will not form a marked feature of this meeting. The only official entertainment on a large scale will be the conversazione at the Winter Gardens on September 10. But Bournemouth is widely famous for its manifold attractions, and members and associates will have no difficulty in finding numberless opportunities for relaxation and amusement in their leisure hours.

In a popular seaside resort in September the pressure on the available accommodation will probably be great. Those attending the meeting

are therefore advised to make their hotel or lodging arrangements without delay. The local executive committee is doing everything in its power to help them in this direction, and inquiries addressed to the Local Secretaries, Municipal Buildings, Bournemouth, will bring prompt and full information on the subject.

NOTES.

THE visit of the King and Queen to the British Scientific Products Exhibition at the Central Hall, Westminster, on Tuesday, is a mark of Royal approval which will be highly appreciated, not only by the British Science Guild, which is responsible for the enterprise, but also by all who are working for the advancement of science and the extension of its industrial applications. Their Majesties, who were accompanied by Princess Mary and Prince Henry, were received by the Marquess of Crewe, president of the exhibition, and several members of the organising committee. They remained in the exhibition for about an hour and a half, and took the keenest interest in numerous machines, instruments, and products displayed, particularly in the exhibits of optical and laboratory glass and instruments, dyes and fine chemicals, radium, high-speed telegraphic printing, magnetos, Hadfield steels, potash salts from blast-furnace dust, seed-testing, and fruit and vegetable preserving. Both the King and Queen expressed much satisfaction that so many objects in the exhibition represented things formerly obtained chiefly or entirely from abroad, and congratulated the organisers of the exhibition upon the educational and practical value of this display of British productions. Their visit was a most encouraging sign of Royal concern for national activities which receive little official or public attention, though they are of prime importance; and it will doubtless induce many people to see for themselves what is really a stimulating display of scientific and industrial achievement.

A FUND is being raised in the medical profession to present Sir Clifford Allbutt with his portrait. Sir Clifford Allbutt has been, above all things, a great clinical teacher, first in Leeds and, after his appointment to be Regius professor of physic in 1892, in Cambridge. He was one of the first to show the value of the ophthalmoscope in the diagnosis of diseases of the nervous system, the kidney, and certain other general disorders; his volume on this subject was published in 1871. During the years 1896–99 he edited a great "System of Medicine," which had a success so immediate that a second edition was almost at once demanded. In the preparation of this, which appeared at intervals from 1905 to 1910, he was associated with Sir Humphry Rolleston. Sir Clifford Allbutt was elected president of the British Medical Association in July, 1914, and has retained that position throughout the war. The council of the British Medical Association, therefore, has taken the lead in asking for subscriptions to the fund to present Sir Clifford Allbutt with his portrait, to be painted by an eminent artist. From the portrait it is intended to commission a mezzotint engraving, which subscribers to the fund will be able to purchase for their own collections. Subscriptions, which are limited to one guinea, should be made payable to the "Sir Clifford Allbutt Presentation Fund," crossed London County, Westminster, and Parr's Bank, and addressed to the Treasurer of the British Medical Association, 429 Strand, London, W.C.2. A large number of subscriptions have already been received, and it is proposed to close the fund at the end of this month.

THE council of the British Association recently instructed a deputation, consisting of Prof. Arthur Keith, Sir Edward Brabrook, and Prof. A. W. Kirkaldy, to wait upon the Ministry of Pensions in order to urge the utilisation of anthropometric and kindred data collected by the disbanded Ministry of National Service. The deputation was received on behalf of the Minister of Pensions by Col. Arthur L. A. Webb, Director-General of Medical Services, Ministry of Pensions, who explained that the medical statistical department of the Ministry of National Service, of which Dr. H. W. Kaye was in charge, and the data collected by that department, had been taken over by the Ministry of Pensions. Under the Ministry of Pensions Dr. Kaye had not only to direct the compilation of medical recruiting statistics, but also to organise a special branch to deal with medical data connected with the Ministry of Pensions. It was thus impossible for Dr. Kaye's department to give its undivided attention to the preparation of returns relating to the physique of recruits in the various areas and trades of the country. At the present time all the data relating to Grade IV. men were being examined and compiled. Col. Webb also explained that Dr. Kaye's department was endeavouring to obtain data for comparison from Canada, New Zealand, and the United States. The deputation, before withdrawing, thanked Col. Webb, and urged the early publication of results, which are now needed by all who are studying problems connected with the present physical condition of our population.

THE council of the Institution of Electrical Engineers has issued a pamphlet on the Electricity (Supply) Bill, 1919, now before a Committee of the House of Commons. It is pointed out that great injury to the national interest has resulted from ill-considered electrical legislation in the past, and naturally electricians are anxious about the future. The appointment of Electricity Commissioners is welcomed provided that these Commissioners give whole-time service and appoint an Advisory Council, membership of which is restricted to persons possessing expert qualifications. The proposal that the Commissioners undertake and promote research also is approved. There is opposition to the proposed terms for the purchase of generating stations. Parliament is urged not to break faith with those who have invested their capital on the strength of the powers conveyed by earlier legislation. Having regard to the fact that practically every industry in the country is concerned directly or indirectly with electricity supply, it is more fitting that the Electricity Commissioners should be responsible to Parliament through the President of the Board of Trade, and should not be under the Ministry of Ways and Communications. This point is strongly emphasised.

THE death is announced, at sixty-seven years of age, of Prof. Emil Fischer, professor of chemistry in the University of Berlin, foreign member of the Royal Society, and Nobel laureate in chemistry in 1902.

THE death is announced, in his seventy-fourth year, of Dr. Elwyn Waller, who from 1885 to 1893 was professor of analytical chemistry at the School of Mines, Columbia University. From 1872 to 1885 Dr. Waller was chemist to the New York Health Department. He was the author of several text-books on chemistry.

Mrs. Menteith Ogilvie has presented to the Natural History Museum the fine collection of British bird-skins formed by her late husband, Dr. Menteith Ogilvie. It consists of nearly 1800 specimens, many of the species being represented by large series. The collection is in a very good condition, each bird being carefully identified and labelled, with full data. The birds of prey are particularly well represented. There are three examples of the hen harrier, a decreasing British species, and seven of Montagu's harrier, which is a somewhat rare spring and summer visitor. There is a very large series of the sparrowhawk, showing every change and phase of plumage from the nestling in its various stages to the adult bird. There are also good series of the great crested grebe from Norfolk and Suffolk, of the Slavonian grebe, and of the little auk, also from Norfolk and Suffolk.

Dr. H. R. Mill has retired from the position of director of the British Rainfall Organisation and from the editorship of "British Rainfall" and *Symons's Meteorological Magazine*, which he has carried on since 1901. Serious impairment of eyesight consequent on overwork led Dr. Mill to make arrangements for retiring in 1914, when the outbreak of the war caused him to postpone the step; he now finds his health unequal to the strain of adapting the work to post-war conditions. The association of voluntary rainfall observers in all parts of the British Isles numbered 3500 nineteen years ago; it had reached 5500 in 1914, and, after falling to about 5100 during the war, the number is again increasing. The collection and publication of rainfall data will not be interrupted by the changes consequent on Dr. Mill's retirement.

The sudden death on July 5 of Mr. John Hopkinson at his home in Watford is a sad loss to the pursuit of natural knowledge, both in Hertfordshire and in wider fields. It was so far back as 1875 that Mr. Hopkinson founded the Watford (now Hertfordshire) Natural History Society, and for more than forty years the promotion of its interests had been his chief concern. The eighteen volumes of Transactions are sufficient evidence of the success of his efforts; to them he contributed frequently on meteorological, phenological, and geological topics, and the whole series has had his meticulous editorial care; and his sturdy Yorkshire shoulders carried a good deal more than the local society. The admirable County Museum at St. Albans arose from his proposal, and he was the originator of the annual conference of delegates from provincial scientific societies held in connection with the British Association. For some fifteen years he had been secretary of the Ray Society, and always the helpful friend of naturalists of all kinds. Mr. Hopkinson was active to the last, and few men have made better use of seventy-four years.

By the death of Dr. John Inglis on July 13 the Clyde loses one of its best known pioneers in scientific shipbuilding. An account of Dr. Inglis's career appears in *Engineering* for July 18, to which we are indebted for the following particulars. He was born in 1842, the eldest son of Anthony Inglis, who founded the firm of A. and J. Inglis in 1837. He was educated at the Glasgow Academy and at Glasgow University, where he came under the influence of the brothers Thomson, Lord Lister, Rankine, Blackburn, and others. He became manager of the shipbuilding yard at twenty-five years of age. He was amongst the first to adopt the principle of progressive-speed trials on the measured mile and of careful study of the results achieved. Dr. Inglis was associated with Dr. Froude's method of tank experiments with models of different forms and with comparative screw propellers. He was the first on the Clyde to carry out inclining experiments on completed vessels with the view of determining their stability and of assisting towards accurate loading. He was also a pioneer in the determination of longitudinal stresses, and conducted many experiments on a practical scale. He was vice-president of the Institution of Naval Architects, and president of the Institution of Engineers and Shipbuilders in Scotland in 1893, and of the Institute of Marine Engineers in 1898. Much of his private time was devoted to the advancement of the national organisations and institutions in Glasgow. In 1898 the honorary degree of LL.D. was conferred upon Dr. Inglis by the University of Glasgow.

As a result of the establishment of the Ministry of Health, the medical staffs of the Local Government Board and of the National Health Insurance Commission have been brought together to form the main portion of the medical staff of the Ministry, but on a newly organised system and with considerable additional posts. The Minister has appointed Sir George Newman as Chief Medical Officer of the Ministry, with status corresponding with that of a Secretary of the Ministry. By arrangement between the President of the Board of Education and the Minister, Sir George Newman is to retain his position as Chief Medical Officer of the Board of Education. Five new posts of Senior Medical Officer have been established, and to these the following appointments have been made:—Dr. G. S. Buchanan, Dr. Janet M. Campbell, Dr. F. J. H. Coutts, Mr. A. W. J. MacFadden, and Mr. J. Smith Whitaker. The whole of the rest of the established medical staff of the Ministry will be in one grade to be known as Medical Officers. The following appointments have so far been announced:—Miss Irene C. D. Eaton, Dr. Major Greenwood, Miss Florence B. Lambert, and Dr. Jane H. Turnbull. Besides this regular staff, arrangements have been made whereby the Ministry may secure the services, from time to time, of specialists and others on a part-time basis. Amongst these are included at present the following:—Dr. Maurice Craig, Col. L. W. Harrison, and Sir David Semple.

By direction of the President of the United States, the U.S. Distinguished Service Medal has been awarded to Lt.-Col. S. J. M. Auld, Royal Berkshire Regiment, British Army, "for exceptionally meritorious and distinguished services rendered the United States Army while serving as Liaison Officer between the British and American Chemical Warfare Services." Col. Auld, who is professor of agricultural chemistry at University College, Reading, commanded the British Gas Warfare Mission to the United States, other well-known members of which included Major H. R. Le Sueur and Major H. W. Dudley. This Mission put before the Americans everything about gas warfare *ab initio*, and Col. Auld was responsible for organising the American Chemical Warfare Service, which developed into the largest gas service of all the combatant armies. When the armistice was signed the United States were manufacturing nearly twice as much gas as all the other combatant nations (including Germany) put together. The American respirator was an improved copy of the British box respirator. The field training was also based on British experience. The exchange of manufacturing, design, and research experience between the two nations was absolutely complete, the relationship between the two Chemical Warfare Services being closer than in any other branch of the Service, and doing much to consolidate the cordial understanding already existing between the chemists of the two countries.

MR. R. A. SMITH describes in the issue of *Man* for July a discovery of flint implements from Victoria West, in the heart of the Great Karroo, South Africa. Among them are examples of what are known as "tortoise-cores," best known in Europe from Northfleet, in Kent, and from Montières, near Amiens, and dating from the period of Le Moustier, to which they are probably confined. The core was prepared with the object of getting an ovate flake-implement from the upper face by a final blow on the faceted bulb. This, if successful, was a special case of the Levallois flake. Those from Victoria West are rather pointed at one end, and generally struck from the left edge near the point; in a few cases the detaching blow was struck on the right of the point.

IN a paper entitled "Customs Connected with Death and Burial among the Roumanians," published in the June issue of *Folk-lore*, Mrs. A. Murgoci has collected much interesting information less known than it deserves to be in western Europe. The accounts of the death feasts are curious, still more the custom of disinterring the dead seven years after burial; when a death feast is given for the last time, the bones are washed in wine, put in a smaller coffin, and reburied. At present the priests are overburdened with work, for not only have they an unusually large number of deaths to deal with, but they are now beginning to be occupied in digging up those who died before the war. On the Monday after Easter Monday women put the red shells of the Easter eggs into water in the hope that they may be thus conveyed to the Blajini, the good men who live in some other world and are ignorant of what passes in this. When they see the egg-shells floating within their view, they know that Easter has come, and they, too, rejoice.

THE South London Entomological and Natural History Society takes a high place among associations of the kind for the thoroughness of its work and for the excellence of its published Proceedings. The activities of the society are chiefly entomological, and the contributions of many of its members to our knowledge of the morphology and ontogeny of native insects are of great value. The last published volume of Proceedings contains a well-written summary of recent work in economic entomology, both British and foreign, delivered as his annual address by the president, Mr. Stanley Edwards. A careful analysis of variation in the wing-markings of *Epinephele tithonus*, compared with other species of Satyrid butterflies, and illustrated by two excellent photographic plates, is contributed by Mr. G. Wheeler. Other elaborate studies of variation in Lepidoptera are furnished by Mr. H. J. Turner and Mr. A. Sich. The reports of meetings, with notes of discussions and the exhibition of specimens, are adequately given, and accounts are included of various excursions and visits, including one to the John Innes Horticultural Institute at Merton, and another to Wimbledon Common, where the natural features of the site appear to have suffered less interference of late years than might have been expected. There is a brief notice of a lecture by Prof. A. Dendy on sponges, and an abstract of a lecture by Miss G. Lister on the Mycetozoa. Altogether there is reason to congratulate the members on the healthy condition of their society, and we should not omit to mention that a full index much enhances the value of the present volume.

THE Bulletin of the Imperial Institute, vol. xvii., No. 1, for this year contains an important article on the cocoa production of the Empire. The quantity of cocoa produced in British countries in 1913 was more than three times the amount consumed in the United Kingdom, yet this country obtained only about one-half of its supply from these sources. Large quantities of prepared cocoa and chocolate were also being imported from foreign countries which had been manufactured there from British-grown cocoa. During the war the position improved, and about 86 per cent. of the total imports came from British possessions in 1917. The money value of the imports in 1916 was 6¾ million pounds sterling, so that the importance of the matter can readily be realised. Two points are worthy of special mention: first, the remarkable growth of the cocoa industry on the Gold Coast, which colony started to export cocoa in 1891; and, secondly, the enormous increase in the consumption of cocoa in the United States in recent years. The consumption has trebled since 1913, and about one-half of the total quantity produced in the world now goes to the States.

THE possibility of growing New Zealand flax (*Phormium tenax*) on a commercial scale in the British Isles has for many years been under consideration, and the publication of an important paper on the subject in *Kew Bulletin*, No. 4, is of considerable interest. From the account there given it is clear that in south-west Ireland, south-west Scotland, and possibly in the south of England, the successful cultivation of New Zealand flax is a definite possibility. The article, which mainly consists of an account of Lord Ventry's successful experiments in co. Kerry, is illustrated by several photographs of New Zealand flax under cultivation in Ireland showing a remarkably vigorous growth. The fibre of this Irish-grown flax has been tested at Belfast, and has been found almost as good as "Good-fair" imported fibre from New Zealand, which was valued in July, 1914, at 32*l*. per ton. As paper-making material, the leaves have also been very well reported on by the Irish Paper Mills Co. near Dublin. The great value of New Zealand flax, however, is its fibre, which is used for making binder twine and high-grade string and cord. As the demand for this is a very heavy and rising one, the possibility of growing New Zealand flax for the purpose in the British Isles is of considerable importance. It is pointed out in the article that only certain parts of the United Kingdom are suitable for the growth of New Zealand flax as a commercial undertaking, but as the results so far obtained are promising, it is to be hoped that every encouragement will be given to the enterprise, which promises to yield a sound financial return to the impoverished farmers in the south-west of Ireland in particular.

THE U.S. Bureau of Standards Technologic Paper No. 128 (copies of which may be obtained on application to the Bureau) deals with the effect of solar radiation upon balloons from the thermal point of view. After discussing the characteristics of radiation from the sun and the effects of its absorption by balloon fabric, the authors give the results of reflection and transmission measurements on nineteen different samples with Coblentz's apparatus, using light from the sun and from a nitrogen-filled tungsten lamp with copper chloride filter. With a model airship 12 ft. × 3 ft. the temperatures of the fabric and of the contained gas were determined in sunlight; the temperature-rise of the upper fabric was found to be proportional to the cosine of the angle between the sun's rays and the normal to the surface; the minimum temperature occurred just below the shadow line, and not at the bottom. In the lower half of the

balloon the temperature of the gas was uniform, although there was a difference of 25° C. between this and the gas temperature at the top. It is calculated that in still air as much as 80 per cent. of the total heat loss from the upper surface of the model might be due to radiation from the fabric. For obtaining the minimum heating effect on an airship in sunlight the use of aluminium-coated fabric is recommended, since this also affords good protection against actinic light.

In view of the successful round voyage of the naval airship R 34, great interest is attached to a fully illustrated account of this vessel which appears in *Engineering* for July 18. The vessel has a length of 645 ft. over all, and a maximum diameter of 78 ft. 9 in. Its gas capacity is about 2,000,000 cub. ft., giving a gross lift of 60 tons under standard conditions. The disposable lift is just under 30 tons. The hull is of fine stream-line form, and is constructed of main transverse frames spaced 10 metres apart, and built in the form of a polygon with thirteen sides. The frames are joined at each angle of the polygon by longitudinal girders, and there are intermediate frames in each space, both transversely and longitudinally. The exterior polygon of twenty-six sides thus formed has the outer cover stretched over it. The girders are constructed of duralumin. There are eighteen gas-bags, composed of high quality single-ply cotton fabric, lined with rubber on the inner surface. On this surface goldbeaters' skins are stretched and secured with rubber solution, and the whole is then varnished over. Each gas-bag has an automatic relief valve. There are five cars, one for navigational purposes, and all the others contain engines. The five engines are of 270 h.p. each, and give a speed of 55 knots in still air. The photographic illustrations of the ship under construction and in flight are particularly interesting, and give very clear views of the details of construction.

Messrs. Hodder and Stoughton have in the press the New Teaching Series, which has been arranged to meet new demands in education as to method and curriculum. The subjects of the volumes in hand include:—Chemistry from the Industrial Viewpoint, Applied Botany, Industrial Geology, Geography of Commerce and Industry, Chemistry and Bacteriology of Agriculture, Everyday Mathematics, Mathematics of Engineering, Foundations of Engineering, Mathematics of Business and Commerce, and Industrial History.

Messrs. H. K. Lewis and Co., Ltd., have removed their publishing, wholesale, and advertisement departments to 28 Gower Place, W.C.1. The change not only provides larger and more convenient accommodation for publishing work, but the space vacated in the old premises affords much needed additional room for the library and bookselling business. A new and convenient reading-room is to be added to the library over the present library room.

Messrs. Longmans ask us to say, in correction of an announcement in last week's Nature, that though the edition on large paper of "A Naturalist's Sketch Book," by A. Thorburn, which they will publish in the autumn, will be limited to 105 copies, the ordinary edition of the book will not be limited in number.

The offices of the Imperial Mineral Resources Bureau have been moved from 14 Great Smith Street to 2 Queen Anne's Gate Buildings, Westminster, S.W.1.

OUR ASTRONOMICAL COLUMN.

A Bright Meteor.—A large meteor with unusually slow motion was observed at Bristol on July 20, 11.2 G.M.T.; it had a double nucleus, and passed over 42° of the sky in 12 seconds. The observed path was from $37°+47°$ to $4°+15\frac{1}{2}°$. The meteor was of a red colour, like Mars, and probably from a radiant in Leo at about $155°+25°$. It is curious that the great fireball seen in America on July 20, 1860, had a radiant point in the same region of the sky, and may be assumed to have been derived from the same cometary system. Further observations of the meteor of July 20 last would be valuable, and Mr. W. F. Denning, 44 Egerton Road, Bristol, will be glad to receive any.

The Light of the Aurora and the Auroral Line.—Observation of the brightness of the background of the sky by various observers has shown that it must be due to some other cause than the diffused light of the stars themselves, and the suggestion has been made that this is the effect of the existence of a permanent aurora. In the *Astrophysical Journal* for May Prof. Slipher publishes an account of some spectrographic observations which have a direct bearing on the point. He says that during three and a half years something like one hundred spectrograms were made of the night sky, and every one of them recorded the chief auroral line, so that during this period of time auroral illumination of the sky was found to be present on every night that an exposure was made for detecting it. Incidentally, Prof. Slipher made a determination of the wave-length of the green auroral line, which he finds to be longer than the generally accepted value, λ 5571. Prof. Frost, in an editorial note, corroborates the fact from inspection of one of the spectrograms that the green line falls at a point of greater wave-length than the solar line λ 5573, and it appears that the wave-length of the auroral line is substantially λ 5578·05.

The Spiral Nebulæ.—A reprint from the Journal of the Washington Academy of Sciences for April 19 gives an abstract of a lecture delivered by Prof. H. D. Curtis, of the Lick Observatory, on certain modern theories of the spiral nebulæ. The author forms the opinion that these nebulæ are island universes, and not part of our galactic system, a line of argument adduced to show this being as follows:—The spiral nebulæ have large radial velocities shown by the spectroscope, their average speed being nearly five hundred miles a second, but by repeating photographs taken about thirteen years ago and comparing them with the earlier ones, Prof. Curtis finds no evidence of proper motion or motion at right angles to the line of sight which it is to be expected these objects should have, since their space velocity is high. The conclusion to be drawn is that the cross-motion does not show because the nebulæ are very remote, so remote that they must be far outside the generally accepted limits of the bun-shaped figure known as our stellar system. An argument in favour of the island universe theory, drawn from the appearance of Novæ, may be repeated. The brighter Novæ of the past have almost invariably been located in or close to our Milky Way, and therefore have evidently been part of our stellar system. In the course of a few years a dozen Novæ have been found in spiral nebulæ, all very faint, and the life-history of these has been essentially the same as that of the brighter Novæ. There is thus a presumption, though not a very rigid proof, that the phenomena of the spirals are similar to those of our galaxy, and therefore that they themselves are galaxies.

CHEMISTS IN CONFERENCE.

THE Society of Chemical Industry held its annual meeting in London on July 15–18, and, in order to emphasise the fact that its outlook is industrial rather than academic, the conferences took place in the City, and not, as hitherto, in South Kensington. The opening meeting was held at the Mansion House, and the society was welcomed by the Lord Mayor; other conferences were held at the Salters' Hall, Goldsmiths' Hall, and Clothworkers' Hall, and the foreign delegates were privileged to lunch in the picturesque and old-world hall of the Girdlers' Company.

It has already been announced in these columns that an Inter-Allied Chemical Council has been formed for the promotion of co-operation between the chemists of Belgium, France, Great Britain, Italy, and the United States. During the last year or so there has also grown into existence an International Research Council, which has met in Rome and Paris, and is this week holding an important conference in Brussels. This council contemplates the organisation of research and publication in all branches of science and in all countries, except Germany and Austria, and there was a good deal of discussion among the British and Allied chemists at their conferences last week as to how the Inter-Allied Council could fit into the scheme of organisation contemplated by the International Research Council. It was at length decided to announce that the Inter-Allied Chemical Council was of opinion that this body should be the chemical section of the International Research Council, and should do all the work of organisation and publication which was required in connection with chemistry, both pure and applied. A deputation was sent to Brussels to express this view and to co-operate with the other *savants* there assembled. Amongst the delegates to Brussels we may mention Prof. Chavanne, Dr. Lucion, and M. Timmermans, representing Belgium; Profs. Moureu and Béhal, representing France; Sir William Pope and Dr. Ruttan (of Canada), representing the British Empire; and Lt.-Col. Bartow, Dr. Parsons, and Dr. Washburn, representing the United States. It is understood that Canada and Poland have expressed a wish to be represented on the Inter-Allied Chemical Council, and are now admitted as such, and that the other Allies who have signed the Treaty of Peace will be asked to become constituent bodies.

Among the papers read at the Mansion House on July 15 was a very eloquent and interesting appreciation of the late Sir William Ramsay by Prof. C. Moureu, the president of the Inter-Allied Council. Prof. Moureu described the researches of the late Lord Rayleigh on the density of nitrogen, and gave an account of the excitement produced at the British Association at Oxford in 1894 when Lord Rayleigh and Sir William Ramsay announced their discovery of argon. He mentioned as characteristic of Sir William Ramsay the speed with which he followed up a hint given in a letter from Sir Henry Miers as to a gas contained in cleveite and detected by Hillebrand. This led to the discovery of helium, which was spectroscopically detected in the sun so long ago as 1868.

Prof. Moureu gave some account of his own original work on the occurrence of helium in fire-damp and in the gases given off by underground springs, and sketched the history of the discovery of neon, krypton, and xenon. Only those who have paid attention to the recent publications are aware that helium occurs to the extent of 6 per cent. in the gases given off by the spring at Maizières, in the Côte d'Or, and to the extent of 10 per cent. in the gas of the spring at Santenay, also in the Côte d'Or. Moreover, krypton, argon, xenon, and neon are usually found in the subterranean gases, and the relative proportions of these four gases are fairly constant. The explanation is suggested that these gases, being chemically inactive, have remained in a constant proportion since the days when our globe was a nebular mass without form and void. It was Sir William Ramsay himself who predicted the use of helium for filling balloons—a prediction which has been recently verified by the work done in the United States under the superintendence of Dr. Cottrell.

An important conference on the production and consumption of sugar within the British Empire was held at the Clothworkers' Hall, the Earl of Denbigh being in the chair. A number of experts took part in the discussion, and a voluminous report is now being prepared for publication.

A group of papers on power plant in chemical works occupied a whole day; these included a paper on waste heat boilers by Capt. C. J. Goodwin and a paper on surface combustion boilers by Prof. W. A. Bone and Mr. P. Kirke. Several speakers directed attention to possible economies in the use of fuel—a matter which is now of the utmost importance to the whole nation.

The conference on dyestuffs was largely attended, and a paper by Dr. Herbert Levinstein on the intimate connection between the German dye manufactures and the supply of explosives and poison gases should make our politicians think furiously. Germany, notwithstanding the Treaty of Peace, is left in the position that she can easily, at a few hours' notice, commence the manufacture of explosives and poison gas on a very large scale. In this country we have at the moment no manufacture which can proceed during peace and at once be switched on to warlike purposes. Mr. E. V. Evans, in his paper on the manufacture of intermediate products in the dyestuff industry, showed how desirable it is to conduct the manufacture of these in a few works on a large scale rather than, as now, the manufacture on a small scale in many works.

There were good papers on other topics dealing, perhaps, with rather technical matters, and a number of papers on chrome tanning and on recent developments in the fermentation industries, including one by Sir Frederick Nathan on the manufacture of acetone.

Industrial chemistry is becoming too large a subject for any individual to master, and the tendency to specialise is manifested, not only in the grouping of a number of cognate papers into one conference, but also in the activities of the recently formed chemical engineering group of the society. On the whole, the papers were of considerable importance, and show that, though the chemists may be tired by their war-work, they are not exhausted.

PHYSIOLOGY AND METAPHYSICS.

A JOINT session of the Aristotelian Society, the British Psychological Society, and the Mind Association has been held annually, though more or less informally, since 1908. This year an attractive and more extended programme was provided on July 11–14, and hospitality was offered by Bedford College, the most delightfully situated and admirably appointed of the University of London colleges. The result was a very large increase in the membership and a sustained interest in the session. Members were furnished in advance with the whole of the written communications constituting the Proceedings. This

had the advantage that at every meeting the papers were taken as read, and the leaders of the discussions could concentrate at once on the important points in theory or criticism of theory which they had set forth.

The subject of discussion at the first meeting was "Propositions: What They Are and How They Mean." The paper was by Mr. Bertrand Russell. It was the outcome of a philosophical research into the tenability of the behaviourist theory in psychology. The neutral monism which forms the basis of this theory had proved very attractive to Mr. Russell, and he put forward as his own view that it is true in so far as that the psychical and the physical are not distinguishable by the stuff of which they are made, but by the order of the causal laws to which they are amenable. He parted from behaviourism, however, on the question of "images." So far as he had been able to go at present, he was convinced that there are images, and he could see no way of interpreting them in physical terms. An interesting discussion followed, led by Dr. G. E. Moore, who presided.

The second meeting attracted the largest audience of the session. The subject was a symposium on "Instinct and the Unconscious," to which Dr. W. H. R. Rivers, Dr. C. S. Myers, Dr. C. G. Jung (of Zurich), Prof. Graham Wallas, Dr. J. Drever, and Dr. W. McDougall contributed. Sir Leslie Mackenzie presided. The interest of this discussion centred round the neurological and psychological discoveries in regard to war-neuroses. Dr. Jung received a warm welcome, and surprised everyone by the ease and fluency with which he expounded his theory in English. The theory created a lively impression. At a subsequent meeting its more philosophical aspect, particularly its relation to Bergson's doctrine of a vital impulse, was the subject of a discussion opened by Mr. J. W. Scott.

The third meeting was a symposium on "Space, Time, and Material: Are They, and if so in what Sense, the Ultimate Data of Science?" Sir Joseph Larmor presided. Sir Oliver Lodge, who had contributed one of the papers, was unavoidably absent, and a reply to a criticism of his thesis was read. The other contributors were Prof. A. N. Whitehead, Prof. J. W. Nicholson, Dr. Henry Head, Mrs. Adrian Stephen, and Prof. Wildon Carr. Two problems emerged in the discussion: the physical problem of continuity and the physiological problem of the nature of the mechanisms and neurological contrivances which condition conscious experience. Prof. Whitehead contended that the first chapter in science, *i.e.* in the systematisation of Nature, must deal with an event. Process is the fundamental fact which requires explanation; there is no element in experience prior to and simpler than an event.

The fourth meeting was devoted to the metaphysical problem of the relation of the finite to the infinite, or, in the terms of the symposium, "Can Finite Minds be Included in the Mind of God?" Lord Haldane presided. The papers were by the Dean of Carlisle, Dr J. H. Muirhead, Dr. F. C. S. Schiller, and the Bishop of Down.

The fifth and final meeting was a symposium on "Is there 'Knowledge by Acquaintance'?" The papers were by Prof. G. Dawes Hicks, Dr. G. E. Moore, Dr. Beatrice Edgell, and Mr. C. D. Broad. Prof. W. R. Sorley was in the chair.

The dominant note in the discussions was, to most of those taking part, the physiological problem. Dr. Head's description of his researches, based on the treatment of war injuries, into the function of the cerebral cortex, and his theory of the survival of older responses beneath the superposed control of the higher centres, though freely criticised, was felt to have important consequences both for psychological and epistemological theory. Also, it left the impression of a new and unsuspected approach to one another of science and philosophy.

The meeting in 1920 is to take place at Oxford, and it is intended to invite the participation of the Société Française de Philosophie.

A LEAGUE OF UNIVERSITIES.

A CONFERENCE of Universities was held at the Imperial Institute on July 18. It was convened in order that representatives of British universities, including such members of the universities of the King's Dominions overseas as are still in England in connection with the war, might take counsel with their colleagues from the U.S.A. Notwithstanding the difficulties created by Peace Day, especially in regard to finding hotel accommodation, the conference was well attended. The subject for discussion was the contemplated extension of the activities of the Universities Bureau. Representatives were invited to give expression to their views regarding the ways in which the Bureau might be of greater service to the universities.

The chairman, Sir Donald MacAlister, was able to announce that, the Treasury having, on the advice of the President of the Board of Education, promised to the Bureau a non-recurrent grant of 5000*l.*, provided the universities made adequate provision for its maintenance, almost all the universities of the United Kingdom had already adopted a proposal made at the last meeting of the conference for each to contribute a sum of 100*l.* per annum to the Bureau funds, and two of the university colleges had promised 50*l.* each. The Treasury grant is intended to enable the Bureau Committee to acquire and furnish premises suitable for the accommodation of the staff and for the reception of visiting professors and immigrant students from the Dominions and foreign countries. Probably in a short time it will be possible to announce the address of the new headquarters.

When the delegates who attended the congress of 1912 decided that it was desirable that a "clearing-house" for universities should be established, they were thinking of it chiefly as an agent for promoting co-operation amongst the universities of the Empire, although its international relations were not absent from their minds. No one then could have foreseen that during the autumn of 1914 and the year which followed, the secretary of the Bureau would be in correspondence with all the universities and colleges of the United States and other neutral countries, or sending them parcels of State papers, books, and pamphlets on the causes of a great war, the responsibility for it, and the moral issues which it raised. Nor could anyone have foreseen that, as an outcome of the war, there would be an urgent demand for co-operation amongst the universities of the Allied and neutral countries, and especially for the interchange of teachers and graduate students, on a scale which will appreciably affect our knowledge of one another's ways of thought and trend of sentiment.

All who look to the League of Nations as the only guarantee of peace recognise that one of its strongest supports would be a League of Universities. In illustration of what may be done to promote such a league, the nine representatives of the universities of the United Kingdom and Capt. Holme, who represented the universities of Australasia, gave an account of their experiences and of the impressions which they received during their recent visit to France as guests of the French Republic, and Dr. Fish, on behalf of Dr. Duggan, the director, who was detained in France, described the aims of the new American Institute of International Education.

SCIENCE IN INDUSTRY.

LECTURES AT THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

IN the course of his lecture on "Explosives" at the British Scientific Products Exhibition on July 18, Mr. James Young, Royal Military Academy, said that during the war ammonal was found to be very suitable for use in military mines and in trench-warfare weapons, being safe and powerful, and having a moderate velocity of detonation. It is equally suitable for industrial use, and the expensive constituent—aluminium—can be reduced to 3 per cent. Blastine was also much used for the same purposes, and as the main constituent, ammonium perchlorate, is now made by electrolytic processes, it has a promising future in industry. It is much more sensitive than ammonal, and therefore not so safe to the users. The invention of amatol, a mixture of T.N.T. and ammonium nitrate, was of great value, and doubled our resources of shell high explosives. As compared with picric acid (lyddite), it is safer to handle, costs about one-third, but is not so shattering, owing to the lower velocity of detonation. It is also suitable for industrial use, and mixtures with as little as 10 per cent. of T.N.T. are effective.

Referring to the important subject of a national factory for the fixation of nitrogen, Mr. Young pointed out that our industries are dependent on national security, which again depends on an Army and Navy provided with an adequate supply of explosives, so that if some industries are key industries, explosives are a master-key. The materials for these should, so far as possible, be home products. Now, nitrates are the foundation of nearly all our military explosives, and most of the others in use, and practically all our nitrates, come from far overseas. If we had been cut off from our supplies during the war it is doubtful if our chemists could have filled the gap in time, for the new artificial processes for the fixation of nitrogen require much experience for their efficient working. A great national factory for the fixation of nitrogen should be established in England without delay. We are already behindhand. The Germans, with more experience, were able to make their own nitric acid for carrying on the war. America has already established a national factory. Millions are to be spent on airships, with problematic results, but, with experience, good returns from such a factory should be a certainty. It would have unique advantages. The principal raw materials are air and water. Nitrates and ammonium compounds are in great demand as fertilisers. In peace the main production would be used as fertilisers and for industrial explosives, and be ready to be switched on to war, if war should come. It would at the same time increase the security of the nation and its agricultural prosperity.

Mr. L. Bairstow pointed out, in his lecture on July 21, that the record of some of the striking developments in aviation in the war period has been presented in such a way as to form an indicator of further progress. In forming the Advisory Committee for Aeronautics in 1909 the British Government showed a wise foresight, for in the hands of a body of men of science inquiries have been systematised and coherence given to a literature which has had a profound influence on British aviation. Attention was directed to specific cases of valuable experimental work both on the model and full-scale. In many ways the use of models under carefully controlled laboratory conditions forms the best means of attack on a new problem. There are scale effects which reduce the accuracy of direct application to the full scale, but many of them are known, particularly those for the main parts. A diagram was given which illustrates the extremely close relation between tests on large and small wings; the experiment is one possessing a considerable degree of accuracy, and the distribution of pressure is sensitive to changes of angle of incidence. The agreement is probably complete within the accuracy of the full-scale experiments, and a committee formed to discuss the value of model experiments concluded by saying:—"It is of great importance that such information should be increased and its use extended by further systematic full-scale research." In dealing with stability, records were shown of the disturbed motions of aeroplanes. Easily obtained, these records show whether an aeroplane is stable or unstable and the degree of its stability. Several types of disturbance were shown, including those of an aeroplane which tends to turn upside down, one which "hunts," *i.e.* shows an increasing oscillation, and others which are stable. The motions indicated by the records are calculable on the mathematical basis given by Prof. Bryan if use be made of the resistance derivatives found in the aerodynamical laboratories. It is in the collection of the latter from specially conducted experiments that the immediate future holds its most important research work.

A conference on "Patents in Relation to Industry" will be held at the exhibition on Thursday, July 31, at 4.30 p.m. Lord Moulton will preside, and among those who will take part in the discussion are Sir Robert Hadfield, Mr. W. S. Reid (chairman of council of the Institute of Inventors), Mr. W. R. Bousfield, Mr. Douglas Leechman, Mr. W. M. Mordey, Mr. James Swinburne, and Sir G. Croydon Marks.

COTTON AND COTTON-SEED INDUSTRIES.

IN an address delivered by invitation before the Manchester Textile Institute on May 28, Mr. E. C. de Segundo discussed the interdependence of the cotton and the cotton-seed industries. Until about 1860, cotton-seed from the plants yielding the cotton imported to Lancashire was a waste product. The value, to the United States alone, of this once waste product was, just before the war, with an average cotton-seed crop, from twenty to thirty millions sterling. Some 95 per cent. of the seed now utilised retains, however, residual fibre to the extent of from 2 per cent. in lightly fibred Indian seed to 12 per cent. of the seed-weight in American Upland, Uganda, and other woolly varieties. This residual fibre includes, besides the "fuzz" proper, some "staple" which has escaped the gin and other fibres too short to be included in "staple." Some part of the residual fibre which is not "fuzz" has long been recovered by saw-linting machines, as "linters," mainly marketed in Germany.

The successful removal of the proper "fuzz" without injury to the seed or to the short fibres has been a more difficult problem. The potential value of "fuzz" has long been recognised, but the attempts to separate the "fuzz" at first gave a product marked by the defect of admixture with pieces of seed-shell and foreign matter. Since 1909 a machine has been in use which turns out "fuzz" in a clean, marketable form free from this defect. Before the war 2000 tons of these short fibres had been imported to Britain for paper-making. During the war 8000 tons of this "hull-fibre" have been used by one United States firm in making explosives.

American practice removes the residual fibre in

three steps. Some 2 per cent. (45 lb. per ton of seed) is recovered in the saw-linting machine as "linters," and about 3 per cent. (67 lb. per ton) in the seed-defibrating machine as "seed-lint"; while some 12 per cent. (112 lb. per ton of seed) is obtained in the hull-defibrating machine as "hull-fibre." All three products now command high prices. Calculated on a pre-war basis, the three grades aggregate 45*s.* per ton of seed; the cost involved is 11*s.* 6*d.* per ton; and the net extra return is about 33*s.* per ton.

The British milling system, which crushes the entire seed, prevents complete recovery of the residual fibre. Even so, and assuming that 2 per cent. of fibre is left on the seed, 2 per cent. could still be recovered as "linters" and 6 per cent. as "seed-lint." The additional value should be 32*s.* per ton of seed, provided the recovery be effected in the oil-milling operation. But it will be preferable, whenever possible, to defibrate the seed in the country of origin. Were Uganda seed defibrated at the ginning in Uganda there would result:—(*a*) A profit on the "linters" and "seed-lint" recovered; (*b*) a reduction of the space occupied by the defibrated exported seed, with a consequent saving of 25 per cent. or more in ocean freight; (*c*) a diminution of the liability of cotton-seed to heat during the voyage and a consequent reduction in insurance rates; and (*d*) a probable increase in the price paid for defibrated as compared with "fuzzy" seed. At pre-war rates these factors, taken conjointly, should mean an increase of 50*s.* per ton in the prices paid for Uganda seed in the British market.

COLLISION OF α-PARTICLES WITH LIGHT ATOMS.[1]

THE discovery of radio-activity has not only thrown a flood of light on the processes of transformation of radio-active atoms; it has at the same time provided us with the most powerful natural agencies for probing the inner structure of the atoms of all the elements. The swift α-particles and the high-speed electrons or β-rays ejected from radio-active bodies are by far the most concentrated sources of energy known to science. The enormous energy of the flying α-particle or helium atom is illustrated by the bright flash of light it produces when it impacts on a crystal of zinc sulphide, and by the dense distribution of ions along its trail through a gas. This great store of energy is due to the rapidity of its motion, which in the case of the α-particle from radium C (range 7 cm. in air) amounts to 19,000 km. per second, or about 20,000 times the speed of a rifle-bullet. It is easily calculated that the energy of motion of an ounce of helium moving with the speed of the α-particle from radium C is equivalent to 10,000 tons of solid shot projected with a velocity of 1 km. per second.

In consequence of its great energy of motion the charged particle is able to penetrate deeply into the structure of all atoms before it is deflected or turned back, and from a study of the deflection of the path of the α-particle we are able to obtain important evidence on the strength and distribution of the electric fields near the centre or nucleus of the atom.

Since it is believed that the atom of matter is, in general, complex, consisting of positively and negatively charged parts, it is to be anticipated that a narrow pencil of α-particles, after passing through a thin plate of matter, should be scattered into a comparatively broad beam. Geiger and Marsden showed not only that much small scattering occurred, but also that in passing through the atoms of a heavy element some of the α-particles were actually turned back in their path. Considering the great energy of motion of the α-particle, this is an arresting fact, showing that the α-particle must encounter very intense forces in penetrating the structure of the atom. In order to explain such results, the idea of the nucleus atom was developed in which the main mass of the atom is concentrated in a positively charged nucleus of very small dimensions compared with the space occupied by the electrons which surround it. The scattering of α-particles through large angles was shown to be the result of a single collision where the α-particle passed close to this charged nucleus. From a study of the distribution of the particles scattered at different angles, results of first importance emerged. It was found that the results could be explained only if the electric forces between the α-particle and charged nucleus followed the law of inverse squares for distances apart of the order of 10^{-11} cm. Darwin pointed out that the variation of scattering with velocity was explicable only on the same law. This is an important step, for it affords an experimental proof that, at any rate to a first approximation, the ordinary law of force holds for electrified bodies at such exceedingly minute distances. It was also found that a resultant charge on the nucleus measured in fundamental units was about equal to the atomic number of the element. In the case of gold this number is believed from the work of Moseley to be 79.

Knowing the mass of the impinging α-particle and of the atom with which it collides, we can determine from direct mechanical principles the distribution of velocities after the collision, assuming that there is no loss of energy due to radiation or other causes. It is important to notice that in such a calculation we need make no assumption as to the nature of the atoms or of the forces involved in the approach and separation of the atoms. For example, if an α-particle collides with another helium atom, we should expect the α-particle to give its energy to the helium atom, which could thus travel on with the speed of the α-particle. If an α-particle collides directly with a heavy atom, *e.g.* of gold of atomic weight 197, the α-particle should retrace its path with only slightly diminished velocity, while the gold atom moves onward in the original direction of the α-particle, but with about one-fiftieth of its velocity. Next, consider the important case where the α-particle of mass 4 makes a direct collision with a hydrogen atom of mass 1. From the laws of impact, the hydrogen atom is shot forward with a velocity 1·6 times that of the impinging α-particle, while the α-particle moves forward in the same direction, but with only 0·6 of its initial speed. Marsden showed that swift hydrogen atoms set in motion by impact with α-particles can be detected like α-particles by the scintillations produced in a zinc sulphide crystal. Recently I have been able to measure the speed of such H atoms and found it to be in good accord with the calculated value, so that we may conclude that the ordinary laws of impact may be applied with confidence in such cases. The relative velocities of the α-particles and recoil atom after collision can thus be simply illustrated by impact of two perfectly elastic balls of masses proportional to the masses of the atoms.

While the velocities of the recoil atoms can be easily calculated, the distance which they travel before being brought to rest depends on both the mass and the charge carried by the recoil atom. Experiment shows that the range of H atoms, like the range of α-particles, varies nearly as the cube of their initial velocity. If

[1] Discourse delivered at the Royal Institution on June 6 by Sir E. Rutherford, F.R.S.

the H atom carries a single charge, Darwin showed that its range should be about four times the range of the α-particle. This has been confirmed by experiment. Generally, it can be shown that the range of a charged atom carrying a single charge is mu^3R, where m is the atomic weight, and u the ratio of the velocity of the recoil atom to that of the α-particle, and R the range of the α-particle before collision. In comparison of theory with experiment, the results agree better if the index is taken as 2·9 instead of 3. If, however, the recoil atom carries a double charge after a collision, it is to be expected that its range would only be about one-quarter of the corresponding range if it carried a single charge. It follows that we cannot expect to detect the presence of any recoil atom carrying two charges beyond the range of the α-particle, but we can calculate that any recoil atom, of mass not greater than oxygen and carrying a single charge, should be detected beyond the range of the α-particle. For example, for a single charge the recoil atoms of hydrogen and helium should travel 4 R, lithium 2·8 R, carbon 1·6 R, nitrogen 1·3 R, and oxygen 1·1 R, where R is the range of the incident α-particles. We thus see that it should be possible to detect the presence of such singly charged atoms, if they exist, after completely stopping the α-particles by a suitable thickness of absorbing material. This is a great advantage, for the number of such swift recoil atoms is minute in comparison with the number of α-particles, and we could not hope to detect them in the presence of the much more numerous α-particles.

In order to calculate the number of recoil atoms scattered through any given angle from the direction of flight of the α-particles, it is necessary, in addition, to make assumptions as to the constitution of the atoms and as to the nature and magnitude of the forces involved in the collision. Consider, for example, the case of a collision of an α-particle with an atom of gold of nuclear charge 79. Assuming that the nucleus of the α-particle and that of the gold atom behave like point charges, repelling according to the inverse square law, it can readily be calculated that, for direct collision, the α-particle from radium C, which is turned through an angle of 180°, approaches within a distance $D = 3{\cdot}6 \times 10^{-12}$ cm. of the centre of the gold nucleus. This is the closest possible distance of approach of the α-particle, and the distance increases for oblique collisions. For example, when the α-particle is scattered through an angle of 150°, 90°, 30°, 10°, 5°, the closest distances of approach are 1·01, 1·2, 2·4, 6·2, 12 D respectively.

In the experiments of Geiger and Marsden, the number of α-particles scattered through 5° was observed to be about 200,000 times greater than the number through 150°. The variation with angle was in close accord with the theory, showing that the law of inverse squares holds for distances between $3{\cdot}6 \times 10^{-12}$ cm. and $4{\cdot}3 \times 10^{-12}$ cm. in the case of the gold atom. The experiments of Crowther in 1910 on the variation of scattering of β-rays with velocity indicate that a similar law holds also in that case, and for even greater distances from the nucleus.

We have seen that Marsden was able by the scintillation method to detect hydrogen atoms set in swift motion by α-particles up to distances about four times the range of the incident α-particle. In Marsden's experiments a thin-walled glass tube filled with radium emanation served as an intense source of rays. Since the lack of homogeneity of the α-radiation and the absorption in the glass are great drawbacks in making an accurate study of the laws controlling the production of swift atoms by impact, I have found it best to use for the purpose a homogeneous source of radium C by exposing a disc in a strong source of emanation. Fifteen minutes after removal from the emanation the α-rays from the disc are practically homogeneous, with a range in air of 7 cm. By special arrangements very intense sources of α-radiation can be produced in this way, and in the various experiments discs have been used the γ-ray activity of which has varied between 5 to 80 milligrams of radium. Allowance can easily be made for the decay of the radiation with time.

In the experiments with hydrogen the source was placed in a metal box about 3 cm. away from an opening in the end covered by a thin sheet of metal of sufficient thickness to absorb the α-rays completely. A zinc sulphide screen was mounted outside about 1 mm. away from the opening, so as to allow for the insertion of absorbing screens of aluminium or mica. The apparatus was filled with dry hydrogen at atmospheric pressure. The H atoms striking the zinc sulphide screen were counted by means of a microscope in the usual way. The strong luminosity due to the β-rays from radium C was largely reduced by placing the apparatus in a powerful magnetic field which bent them away from the screen.

If we suppose, for the distances involved in a collision, that the α-particle and hydrogen nucleus may be regarded as point charges, it is easy to see that oblique impacts should occur much oftener than head-on collisions, and consequently that the stream of H atoms set in motion by collisions should contain atoms the velocities of which vary from zero to the maximum produced in a direct collision. The slow-velocity atoms should greatly preponderate, and the number of scintillations observed should fall off rapidly when absorbing screens are placed in the path of the rays close to the zinc sulphide screen.

A surprising effect was, however, observed. Using α-rays of range 7 cm., the number of H atoms remained unchanged when the absorption in their path was increased from 9 cm. to 19 cm. of air equivalent. After 19 cm. the number fell off steadily, and no scintillations could be observed beyond 28 cm. air absorption. In fact, the stream of H atoms resembled closely a homogeneous beam of α-rays of range 28 cm., for it is well known that, owing to scattering, the number of α-particles from a homogeneous source begin to fall off some distance from the end of their range. The results showed that the H atoms are projected forward mainly in the direction of the α-particles and over a narrow range of velocity, and that few, if any, lower velocity atoms are present in the stream.

If we reduce the velocity of the α-particle by placing a metal screen over the source, it is found that the distribution of H atoms with velocity changes, and that the rays are no longer nearly homogeneous. When the range of the α-rays is reduced to 3·5 cm., the absorption of the H atoms is in close accord with the value to be expected from the theory of point charges. It is clear, therefore, that the distribution of velocity among the H atoms varies markedly with the speed of the incident α-particles, and this indicates that a marked change takes place in the distribution and magnitude of the forces involved in the collision when the nuclei approach closer than a certain distance.

In addition to these peculiarities, the number of H atoms is greatly in excess of the number to be expected on the simple theory. For example, for the swiftest α-rays the number which is able to travel a distance equivalent to 10 cm. of air is more than thirty times greater than the calculated value. The variation in number of H atoms with velocity of the incident α-particle is also entirely different from that to be expected on the theory of point charges. The

number diminishes rapidly with velocity, and is very small for α-particles of range 2·5 cm.

It must be borne in mind that the production of a high-speed H atom by an α-particle is an exceedingly rare occurrence. Under the conditions of the experiment the number of H atoms is seldom more than 1/30,000 of the number of α-particles. Probably each α-particle passes through the structure of 10,000 hydrogen molecules in traversing one centimetre of hydrogen at atmospheric pressure, and only one α-particle in 100,000 of these produces a high-speed H atom; so that in 10^9 collisions with the molecules of hydrogen the α-particle, on the average, approaches only once close enough to the centre of the nucleus to give rise to a swift hydrogen atom.

We should anticipate that for such collisions the α-particle is unable to distinguish between the hydrogen atom and the hydrogen molecule, and that H atoms should be liberated from matter containing free or combined hydrogen. This is fully borne out by experiment.

From the number of H atoms observed it can be easily calculated that the α-particle must be fired within a perpendicular distance of $2{\cdot}4\times10^{-13}$ cm. of the centre of the H nucleus in order to set it in swift motion. This is a distance less than the diameter of the electron, viz. $3{\cdot}6\times10^{-13}$ cm. The general results obtained with α-rays of range 7 cm. are similar to those to be expected if the α-particle behaves like a charged disc, of radius about the diameter of an electron, travelling with its plane perpendicular to the direction of motion.

It is clear from the experiments with hydrogen that, for distances of the order of the diameter of the electron, the α-particle no longer behaves like a point charge, but that the α-particles must have dimensions of the order of that of the electron. The closest distance of approach in these collisions in hydrogen is about one-tenth the corresponding distances in the case of a collision of an α-particle with an atom of gold.

The results obtained with hydrogen in no way invalidate the nucleus theory as used to explain the scattering of α-rays by heavy atoms, but show, as we should expect, that the theory breaks down when we approach very close to the nucleus structure. In our ignorance of the constitution of the nucleus of the α-particle, we can only speculate as to its structure and the distribution of forces very close to it. If we take the α-particle of mass 4 to consist of four positively charged H nuclei and two negative electrons, we should expect it to have dimensions of the order of the diameter of the electron, supposing, as seems probable, that the H nucleus is of much smaller dimensions than the electron itself. When we consider the enormous magnitude of the forces between the α-particle and the H nucleus in a close collision —amounting to 6 kg. of weight—it is to be expected that the structure of the α-particle should be much deformed, and that the law of force may undergo very marked changes in direction and magnitude for small changes in the closeness of approach of the two colliding nuclei. Such considerations offer a reasonable explanation of the anomalies shown in the number and distribution with velocity of the H atoms exhibited for different velocities of the α-particles.

When we consider the enormous forces between the nuclei, it is not so much a matter of surprise that the nuclei should be deformed as that the structure of the α-particle or helium nucleus escapes disruption into its constituent parts. Such an effect has been carefully looked for, but so far no definite evidence of such a disintegration has been observed. If this is the case, the helium nucleus must be a very stable structure to stand the strain of the gigantic forces involved in a close collision.

We have seen that the recoil atoms of all elements of atomic mass less than 18 should travel beyond the range of the α-particle, provided they carry a single charge. Preliminary experiments, in which the α-particles passed through pure helium, showed that no long-range recoil atoms were present, indicating that after recoil the helium atom carries a double charge. In a similar way no certain evidence has been obtained of long-range recoil atoms from lithium, boron, or beryllium. It is difficult in experiments with solids or solid compounds to be sure of the absence of hydrogen or water-vapour, which results in the production of numerous swift H atoms. These difficulties are not present in the case of nitrogen and oxygen, and a special examination has been made of recoil atoms in these gases. Bright scintillations were observed in both these gases about 2 cm. beyond the range of the α-particle. These scintillations are, presumably, due to swift N and O atoms carrying a single charge, for the ranges observed are about those to be expected for such atoms. The scintillations due to recoil atoms of N and O are much brighter than H scintillations, although the actual energy of the flying atom is greater in the latter case. This difference in brightness is probably connected with the much weaker ionisation per unit of path due to the swifter H atom.

The corresponding range of the recoil atoms was about the same in oxygen, nitrogen, and carbon dioxide. Theoretically, it is to be anticipated that the N recoil atom should give a somewhat greater range than the O atom. The recoil atoms observed in carbon dioxide are apparently due to oxygen, for if the carbon atoms carried a single charge they should be detected beyond the range of O atoms.

The number of recoil atoms in nitrogen and oxygen and their absorption indicate that these atoms, like H atoms, are shot forward mainly in the direction of the α-particles. It is clear from the results that the nuclei of the atoms under consideration cannot be regarded as point charges for distances of the order of the diameter of the electron. Taking into account the close similarity of the effects produced in hydrogen and oxygen, and the greater repulsive forces between the nuclei in the latter case, it seems probable that the abnormal forces in the case of oxygen manifest themselves at about twice the distance observed in the case of hydrogen, *i.e.* for distances less than 7×10^{-13} cm. Such a conclusion is to be anticipated on general grounds, for presumably the oxygen nucleus is more complex and has larger dimensions than that of helium.

In his preliminary experiments Marsden observed that the active source always gives rise to a number of scintillations on a zinc sulphide screen far beyond the range of the α-particle. I have always found these natural scintillations present in the sources of radiation employed. The swift atoms producing these scintillations are deflected in a magnetic field, and have about the same range and energy as the swift H atoms produced by the passage of α-particles through hydrogen. The number of these natural scintillations is usually small, and it is very difficult to decide definitely whether such atoms arise from the disintegration of the active matter or are due to the action of the α-particles on hydrogen occluded in the source.

These natural scintillations were studied by placing the source in a closed box exhausted of air about

3 cm. from an opening in the end covered by a sheet of silver of thickness sufficient to stop the α-rays completely. The zinc sulphide screen was fixed outside close to the silver plate. On introducing dried oxygen or carbon dioxide into the vessel, the number of scintillations fell off in amount corresponding with the stopping power of the column of gas. An unexpected effect was, however, noticed on introducing dried air from the room. Instead of diminishing, the number of scintillations was increased, and for an absorption equivalent to 19 cm. of air the number was about twice that observed when the air was exhausted. It was clear from these results that the α-particles in their passage through air gave rise to long-range scintillations which appeared of about the same brightness as H scintillations. This effect in air was traced to the presence of nitrogen, for it was shown in dry, chemically prepared nitrogen as well as in air. The number of scintillations was much too large to be accounted for by the presence of traces of hydrogen or water-vapour, for the effect observed was equivalent to the number of H atoms produced by the mixture of hydrogen at 6 cm. pressure with oxygen. The measurements were always made well outside the range of the recoil nitrogen and oxygen atoms, which we have seen are stopped by 9 cm. of air.

These swift atoms which arise from nitrogen have about the same brightness and range as the H atoms produced from hydrogen, and, presumably, are charged hydrogen atoms. Definite information on this point should be obtained by measuring the deflection of a pencil of these atoms in a magnetic and electric field. The experiments are, however, exceedingly difficult on account of the very small number of the scintillations to be expected under the experimental conditions. It should be mentioned that the evidence so far obtained is not sufficient to distinguish definitely whether these are H atoms or atoms of mass 2, 3, or 4, for the range and brightness of the latter would not be very different from those shown by the H atom.

It is difficult to avoid the conclusion that these long-range atoms arising from the collision of α-particles with nitrogen are not nitrogen atoms, but probably charged atoms of hydrogen or atoms of mass 2. If this be the case, we must conclude that the nitrogen atom is disintegrated under the intense forces developed in a close collision with swift α-particles, and that the atom liberated formed a constituent part of the nitrogen nucleus. It may be significant that from radio-active data we should expect the nitrogen nucleus of atomic mass 14 to consist of three helium nuclei of mass 4, and either two hydrogen nuclei or one nucleus of mass 2.

The effect observed in nitrogen would be accounted for if the H nuclei were outriders of the main nucleus of mass 12. The close approach of the α-particle leads to the disruption of its bond with the central nucleus, and under favourable conditions the H atom would acquire a high velocity and be shot forward like a free hydrogen atom. Taking into account the great energy of the particle, the close collision of an α-particle with a light atom seems to be the most likely agency to promote its disruption. Considering the enormous intensity of the forces brought into play in such collisions, it is not so much a matter of remark that the nitrogen atom should suffer disintegration as that the α-particle itself escapes disruption. The results, as a whole, suggest that if α-particles or similar projectiles of still greater energy were available for experiment, we might expect to break down the nucleus structure of many of the lighter atoms.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Sir J. J. Thomson, Master of Trinity, who recently resigned the Cavendish professorship of experimental physics, has been elected into the newly established professorship of physics. This professorship is without stipend, and will terminate with the tenure of office of the first professor unless the University determines otherwise.

The General Board of Studies has made the following appointments:—Mr. F. W. Dootson, of Trinity Hall, University lecturer in chemistry; Mr. W. H. Mills, fellow of Jesus College, University lecturer in organic chemistry; Mr. R. Whiddington, fellow of St. John's College, University lecturer in experimental physics; and Mr. S. Lees, late fellow of St. John's College, University lecturer in thermodynamics.

EDINBURGH.—On the recommendation of the Secretary for Scotland, the King has appointed Sir Harold H. Styles to the chair of clinical surgery.

The following appointments by the University Court have been announced:—Dr. Meakin, McGill University, to the new chair of therapeutics; Dr. F. D. Boyd to the Moncrieff-Arnott chair of clinical medicine, vacant through the resignation of Prof. Russell; and Mr. T. P. Laird, lecturer in accounting and business method, to become professor when the ordinance for the new chair is approved.

The Court has also resolved to proceed with additional buildings for anatomy, and has approved the plans for a new chemical laboratory.

LEEDS.—The University Council has appointed to the chair of education Dr. John Strong, Rector of the Royal High School, Edinburgh, since 1914.

PROF. T. BRAILSFORD ROBERTSON, formerly professor of biochemistry in the University of Toronto, has been appointed to succeed the late Sir Edward C. Stirling as professor of physiology in the University of Adelaide, South Australia.

THE Encænial proceedings of the University of New Brunswick in Fredericton, the capital, took place in May last. They included the *alumni* oration delivered by Prof. D. Fraser Harris, of the Dalhousie University, Halifax, N.S., who took for his subject "Science and Character-building." Prof. Harris laid stress upon the claims of science as giving a mental training second to no other intellectual exercise. He defined science as that training of the mind which is imparted by a rigorous, unbiased, and sympatheic study of Nature, demanding for its successful pursuit patience, care, exactness, and a strict reverence for truth, all of which qualities are essential to the building up of character, which is something more than being conventionally moral, since weak people can be moral and some conventionally immoral people have been strong characters—for instance, Cæsar, Nelson, and Napoleon. Character is strong without being oppressive, just without being narrow, self-reliant without being self-centred. Science produces heroism in her workers and has had her martyrs, some of whom were enumerated. Truth is what men of character search for, reverence, and seek to declare, and Prof. Harris gave a list of the great men of science who were conspicuous in this regard, strangely omitting the names of Darwin, Tyndall, and Huxley, and naively asked whether it is possible to name an equal number of men as eminent and as reverent in literature, philosophy, or art. Prof. Harris would

have gained much had he carefully studied the close reasoning and the method of treatment of his subject displayed in the address of Huxley on "A Liberal Education and Where to Find It," delivered in the South London Working Men's College in 1868.

SOCIETIES AND ACADEMIES.

SHEFFIELD.

Society of Glass Technology, June 18.—Mr. S. N. Jenkinson, president, in the chair.—S. N. **Jenkinson**: Impressions of a recent tour of the German glass factories. During a tour in Germany Mr. Jenkinson visited Silesia, Saxony, Saxe-Weimar, and other districts, and investigated conditions in several works, particularly glass factories. The size of the glass industry in Germany in pre-war days can be judged from the fact that in 1913 they exported glass to the value of 123,000,000 marks, and pottery to the value of 94,000,000 marks. This amount means that 75 per cent. of their output was exported. It can be realised, therefore, that the outbreak of war caused the shutting down of many German glass factories during 1914–15. The policy during 1915–16 in Germany was to re-open several of the factories and allow one furnace in each works to be kept going, and a scheme was inaugurated whereby finance in the industry was pooled. At the present time very little production of glassware is taking place, due largely to the lack of coal and the state of transport. All the plant in the works was kept in the highest pitch of efficiency, so that immediately opportunity came a high rate of production would follow. Out of some 132 furnaces into which Mr. Jenkinson made inquiries, only eight were working.—Dr. M. W. **Travers**: Some experiments with a gas-fired pot-furnace. The author gave a description of furnaces which had been used in producing chemical glassware, and advocated burning the gas from the producers in front of the pots, and taking the burnt gases out of the furnace at the back.—Edith **Firth**, F. W. **Holden**, and Dr. W. E. S. **Turner**: The properties of British fire-clays suitable for glassworks use. Part i.: The variation of shrinkage, density, and porosity with temperature. (Preliminary communication.) This paper was illustrated by assemblies of fire-clay blocks showing the behaviour of various fire-clays under the tests outlined by the authors. It is the first communication of a research carried out under the auspices of the Refractories Research Committee of the society.—A. V. **Elsden**, O. **Roberts**, and H. S. **Jones**: The examination of optical glass in relation to weathering properties.

PARIS.

Academy of Sciences, June 23.—M. Léon Guignard in the chair.—A. **Lacroix** and M. **Tilho**: The volcanoes of Tibesti.—G. **Humbert**: The positive quadratic forms of Hermite.—A. **Rateau**: The theory of aeroplanes. Principal consequences of the formulæ. A development of a theory outlined in a previous communication.—R. **de Forcrand** and F. **Taboury**: The sulphones formed by sodium, rubidium, and cæsium iodides. The pressures of liquid SO_2 in contact with NaI, CsI, and RbI at $-23 \cdot 5^\circ$, 0°, and $9 \cdot 5^\circ$ were measured, and compared with the pressures of liquid SO_2 alone at the same temperatures. The combinations $NaI+3SO_2$, $RbI+3SO_2$, and $CsI+3SO_2$ were isolated and analysed.—C. **Sauvageau** and L. **Moreau**: Marine algæ as food for horses. *Fucus serratus* and *Laminaria flexicaulis* form good food for horses, the only fault being that at the commencement there may be some difficulty in getting the animals to take them, and there is also a preliminary period during which digestion is incomplete.—M. Widal was elected a member of the section of medicine in succession to the late M. Dastre.—A. **Egnell**: Vectorial fields with indeterminate asymptotic directions.—G. **Rémoundos**: Singularities of differential equations and series capable of summation.—J. **Andrade**: A new method for the experimental study of flat spirals.—L. **Bloch**: The formula of Ritz and the theory of quanta.—H. **Colin** and Mlle. A. **Chaudun**: The law of action of sucrase. Influence of the viscosity on the velocity of hydrolysis. It has been shown in an earlier communication that after the ratio of saccharose to sucrase reaches a certain limit, the velocity of hydrolysis ceases to increase with the proportion of sugar; but for a considerable increase in the sugar concentration above this limit the velocity diminishes, and this is now shown to be due to the increased viscosity. The velocity of hydrolysis under these conditions is a linear function of the fluidity of the solution.—A. **Valeur** and E. **Luce**: The action of hydrogen peroxide upon sparteine and isosparteine.—C. **Gorceix**: The proof of an isostasic post-Glacial movement in the region of Chambéry. Age of the Voglans lignites.—J. **Rouch**: The velocity of the wind in the stratosphere. Observations on the coast, under conditions of clear sky and with moderate wind, show no reduction of velocity in the stratosphere.—J. **Tissot**: Mechanism of the destruction in the serum of the antigen sensitised cell by its specific antibody.—G. **Bertrand**: The mechanism of the preservation of fruit in cold water.

June 30.—M. Léon Guignard in the chair.—P. **Termier**: Transport phenomena of Alpine age in the Rhone Valley, near Avignon.—A. **Rateau**: Theory of the rectilinear rising of aeroplanes. The maximum ascension velocity.—G. **Charpy** and G. **Decorps**: The conditions of formation of coke. A continuation of previous communications by MM. Charpy and Godchot. Since the strength of the coke may vary with the preliminary compression of the charge and with the temperature of the retort, experiments are described in which the effect of change in each of these two variables was studied separately. The effect of a preliminary baking at a low temperature, 500° C., for forty minutes, followed by coking at 900° C., was also studied with interesting results, cokes with very high resistance to crushing being obtained by this means.—M. Andoyer was elected a member of the section of astronomy in succession to the late M. Ch. Wolf.—P. **Boutroux**: A family of multiform functions, integrals of a differential equation of the first order.—G. **Guillaumin**: Forced conduits with variable characteristic.—M. **Létang**: The phenomena which take place during the combustion of powder in a closed vessel.—A. **Cornu-Thénard**: Flexion tests of notched bars by shock.—M. **Brillouin**: The dynamical theory of the atom and the quanta theory.—L. **Benoist**: New porous walls filtering unsymmetrically. A complex filtering plate, consisting of three layers of different porosity, was constructed, the magnitudes of the porosities being 0·30, 0·23, and 0·18. The time of flow of a fixed volume of water under a given pressure was measured and found to vary with the direction of flow, according as it entered the most porous or least porous side of the plate.—H. **Abraham** and E. **Bloch**: Amplifiers for continuous currents and for currents of very low frequency.—G. **Chavanne** and L. J. **Simon**: The preparation of some volatile saturated cyclic or open-chain hydrocarbons contained in petrol.—A. **Guébhard**: Causes of displacement of the earth's crust.—S. **Stefanescu**: The practical application of the characters of the root of the molars of elephants and mastodons.—G. **Guilbert**: The prediction of variations of atmospheric pressure of small amplitude.—P. **Girard**: Physical scheme for the study of mineral nutrition of the cell.—A. **Besredka**:

Mechanism of typhoid infection in the rabbit. Antityphoid vaccination by the mouth.—A. C. **Hollande**: Pathogenic yeast forms observed in the blood of *Caloptenus italicus*.—J. **Dufrenoy**: The parasitic diseases of *Cnethocampa pityocampa* of Arachon pines.—MM. **Yamanouchi**, **Iwashima**, and **Sakakami**: Study of the influenza epidemic of 1918–19. Experiments on fifty-two voluntary subjects proved that the virus is filterable, and is found both in the sputum and in the blood of infected persons.

SYDNEY.

Linnean Society of New South Wales, March 26.—Mr. J. J. Fletcher, president, in the chair.—F. H. **Taylor**: Australian Tabanidæ, No. iv. One new genus is proposed in the subfamily Tabaninæ, and twenty-six species and one variety, referable to the genera Silvius, Cydistomyia, and Tabanus, are described as new.—T. **Steel**: The external parasites of the dingo (*Canis dingo*, Blum.). The occurrence of two fleas (*Ctenocephalus felis* and *C. canis*), a larval tick (near *Ixodes holocyclus*), and a louse (*Trichodectus latus*, or nearly related species) is recorded from a full-grown, pure-bred male dingo.—Dr. R. **Greig-Smith**: The germicidal activity of the eucalyptus oils, part i. When a serum-suspension of *M. aureus* was absorbed in cotton and placed in dilutions of the eucalyptus oils in olive oil for two hours at 20° C., it was found that the bactericidal power was proportional to the acidity of the oils. The germicidal effect was not caused by the acidity, but was assisted by it. The effect upon *B. coli communis* was of much the same nature, although the action of the acid was not so clearly shown. The iodide reaction was no criterion as to the germicidal value of the oils. The vapours of the oils had a decided bactericidal action.

April 30.—Mr. J. J. Fletcher, president, in the chair. —Dr. R. J. **Tillyard**: The morphology and systematic position of the family Micropterygidæ (sens. lat.). Introduction and part i.: The wings. This family of archaic, moth-like insects has been regarded as belonging to the order Lepidoptera until quite recently, when Dr. T. A. Chapman, on one hand, removed the genus Micropteryx alone to a new order Zeugloptera, retaining Eriocrania and its allies in the Lepidoptera, while, on the other, Prof. Comstock has removed the whole family bodily into the Trichoptera. The object of the paper was to elucidate the morphology of the group and to determine its correct ordinal position within the Insecta.—A. H. S. **Lucas**: Notes on Australian marine Algæ. No. ii. Descriptions of four new species.—Dr. A. B. **Walkom**: A collection of Jurassic plants from Bexhill, near Lismore, N.S.W. The known flora of the Clarence series in northern New South Wales is increased from four species to eleven, the additions indicating conclusively that the portion of the series from which they were obtained is of Jurassic age. This flora shows a closer resemblance to the Jurassic flora of Victoria than to any other Australian flora of similar age.

BOOKS RECEIVED.

Four-Place Logarithmic and Trigonometric Tables, together with Interest Tables. Edited by Prof. Louis C. Karpinski. Pp. 30. (Michigan: George Wahr, 1918.) 30 cents.

La Théorie Atomique. By Sir J. J. Thomson. Pp. vi+57. (Paris: Gauthier-Villars et Cie, 1919.) 2.40 francs net.

Géodésie Topométrique. Troisième Fascicule. Détermination du Point par Relèvement. Méthode du Service Hydrographique de la Marine Dite du "Point Approche." By Emile Balu. Pp. vi+57+2 plates. (Paris: Gauthier-Villars et Cie, 1919.) 6 francs net.

Introduction à la Chimie Générale. Lois Fondamentales de l'Atomisme et de l'Affinité Exposées à des Chimistes Débutants. By Prof. H. Copaux. Pp. vi+212. (Paris: Gauthier-Villars et Cie, 1919.) 7.50 francs net.

The Urethroscope in the Diagnosis and Treatment of Urethritis. By Major N. P. L. Lumb. Pp. xii+51+10 plates. (London: John Bale, Sons, and Danielsson, Ltd., 1919.) 10*s.* 6*d.* net.

Annual Reports on the Progress of Chemistry for 1918. Issued by the Chemical Society. Vol. xv. (London: Gurney and Jackson, 1919.) 4*s.* 6*d.* net.

Science and War: The Rede Lecture, 1919. By the Right Hon. Lord Moulton. Pp. 59. (Cambridge: At the University Press, 1919.) 2*s.* 6*d.* net.

Smithsonian Institution: Bureau of American Ethnology. Bulletin 59. Kutenai Tales. By Franz Boas. Together with Texts collected by Alexander Francis Chamberlain. Pp. xii+387. (Washington: Government Printing Office, 1918.)

Senior Practical Chemistry. By H. W. Bausor. Pp. viii+217. (London: W. B. Clive, University Tutorial Press, Ltd., 1919.) 3*s.* 6*d.*

A Dictionary of the Flowering Plants and Ferns. By Dr. J. C. Willis. Fourth edition, revised and re-written. (Cambridge Biological Series.) Pp. xii+712+lv. (Cambridge: At the University Press, 1919.) 20*s.* net.

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THURSDAY, JULY 31, 1919.

APPLIED CHEMISTRY.

(1) *Boiler Chemistry and Feed-Water Supplies.* By J. H. Paul. Pp. ix + 242. (London: Longmans, Green, and Co., 1919.) Price 14*s*. net.

(2) *Reports of the Progress of Applied Chemistry.* Issued by the Society of Chemical Industry. Vol. iii. Pp. 495. (London: Society of Chemical Industry, 1918.) Price 10*s*. 6*d*.

(3) *Trinitrotoluenes and Mono- and Dinitrotoluenes: their Manufacture and Properties.* By G. Carlton Smith. Pp. vii + 133. (London: Constable and Co., Ltd., 1918.) Price 8*s*. 6*d*. net.

(1) MR. J. H. PAUL is a well-known authority on the chemical principles involved in the management and control of steam-boilers, especially in regard to the nature and selection of their feed-waters and of their treatment in the prevention of boiler-scale and corrosion.

In the book before us, which has been written mainly for the use of engineers and practical men possessing, presumably, a limited knowledge of chemistry and of chemical terminology, the author has sought to explain, in non-technical language, the character of the reactions which occur in natural waters containing a variety of soluble saline substances, when heated for the purpose of steam-raising at the relatively high temperatures and pressures of modern boiler practice. The nature of the changes which may occur under these conditions is probably more complex than is usually assumed, and certain of them are possibly complicated by the circumstance that they are of the character of reversible reactions, and subject to the laws of mass action and to the variable influence of temperature and concentration.

In some seventeen chapters the author describes the various forms of natural water, with special reference to their suitability for steam-raising; the nature of their saline constituents; the composition of the various scales and boiler deposits; modes of softening water; the character and influence of the permanently soluble salts; the action of carbonic acid; its behaviour towards iron; the general question of boiler corrosion, its causes and prevention; good and bad boiler practice, etc. The book is largely based upon personal experience, and contains the results of numerous original analyses of water-supplies of all kinds and from all parts of the world, and of various deposits, internal and external. It can be recommended as a trustworthy guide to those concerned in boiler work. It will be gathered that it deals more with practice than with theory, and it must be stated that the rational explanation of certain of the phenomena given by the author is open to question; indeed, it is admitted that the section of the work dealing with the action of carbonic acid on iron is largely speculative, and may have to be modified when more is known on the subject. In spite of his avoidance, as a rule, of technical language, the author is constrained at times to express reactions by means of chemical equations, of some of which the validity cannot be considered as established, and it somewhat savours of dogmatism to neglect the evidence of other observers. "It has been felt that the principle of giving authorities is a subterfuge for passing on to others a responsibility an author has not the courage to assume on his own account." This is surely a very unscientific attitude of mind. There should be here no question of subterfuge or of courage or the lack of it. He who wishes to gain, as fully as possible, a knowledge of the facts desires to have an independent corroboration of them, and for Mr. Paul to arrogate to himself an *ex cathedra* position as the sole authority detracts from, rather than enhances, the weight of his testimony. As a searcher for the truth it is incumbent on him to cite whatever evidence bears upon it.

(2) Vol. iii. of the annual reports issued by the Society of Chemical Industry deals with the progress of applied chemistry made during 1918. As in the case of the two previous reports, it is mainly based upon material published by the society in its fortnightly journal issued during that year. Its plan is practically identical with that of its predecessors, and many of its contributors are the same as in previous cases. Two important sections are added, viz. agricultural chemistry and foods. On the other hand, three are omitted, viz. ceramics, building materials, and fermentation industries, as the compilers of these sections failed to send in their copy in time to be included in the present volume. Considering the range of material to be dealt with, and the number of contributors engaged, *lâches* of this kind are probably unavoidable, but they detract, of course, from the value of the report as a comprehensive and complete summary of the particular year's work, and necessitate, as in the present case of the added sections on foods and agricultural chemistry, the compression of the work of several years in a single report. There is, to this extent, a certain lack of uniformity in treatment and an absence of continuity which are to be regretted, but for which the editor and the publication committee are scarcely to be held responsible.

In the present volume the various departments of applied chemistry treated of are grouped under twenty-two sections. It is obviously impossible, in the limited space at our disposal, to deal with them all in detail, and we propose to select those for the purpose of comment which are of general interest or of particular importance at the present time of "reconstruction."

The value of these annual reports is greatly increased when particular sections are handled in successive years by the same author, provided that he is competent and has the necessary critical skill; and the excellence of his summary is augmented if he prefaces it by a general statement of the more striking marks of progress which

have characterised the year's work. Such a statement is probably best put together after the detailed account of the year's literature has been compiled, and when, as it were, the material has been brought to focus. The greater number of the contributors, especially those who have been engaged on previous reports, actually make these general surveys, but the practice is not uniform, and the surveys are neither of the same interest nor show the same grasp and critical skill. This perhaps is to be expected. Progress in some departments of applied chemistry is very slow, especially in minor industries, and such developments as do occur are often not particularly striking.

Of the new contributors, Dr. Dunn, of Newcastle-upon-Tyne, contributes an admirable *résumé* on "Fuel," in which he deals with a wider range of literature than is noted in the society's journal; Mr. Alwyne Meade, of the Commercial Gas Co., Wapping, treats of "Gas-destructive Distillation-Tar Products" in a well-arranged and succinct digest of some twenty pages; while Mr. Arnold Philip, the Admiralty chemist at Portsmouth, occupies about the same space with an excellent *résumé* of the present position of the mineral oil industry, with special reference to its applications as fuel. Although the matter is not, strictly speaking, relevant to the title of this particular section, Mr. Philip is naturally led to discuss the question of the possible substitution of alcohol, wholly or in part, for petrol as a motor-fuel—a question which is again being actively ventilated owing in great measure to the present high price of petrol. The author is evidently not very sanguine that alcohol is likely to play any considerable part as a motor-spirit unless some form of co-operation on the part of motor users, or some form of control by the State, as in Germany, checks the destructive competition between the producers of alcohol and of petrol which will inevitably set in. As matters stand at present the great petroleum corporations can at any time afford to undersell alcohol, and can undoubtedly ruin any undertaking engaged in the manufacture of industrial alcohol for motor-fuel. The question has engaged the attention of a Departmental Committee, and a report upon it has recently been issued. The whole matter is beset with administrative difficulties, and will presumably need legislative action, if any practical effect is to follow from the Committee's report.

Other new contributors are Capt. Nash, of the Chemical Warfare Department, on "Paints, Pigments, Varnishes, and Resins"; Dr. Twiss, of the Dunlop Rubber Co., on "Indiarubber"; Mr. F. C. Thompson, of the Leather Industries Department of the University of Leeds, on "Leather and Glue"; Dr. E. J. Russell, of the Rothamsted Experimental Station, on "Agricultural Chemistry"; Mr. L. P. Ogilvie, the technical editor of the *International Sugar Journal*, on "Sugars, Starches, and Gums"; Dr. Bywaters, lecturer on general metabolism at the Bristol University, on "Foods"; Dr. Ardern, the chief chemist of the Manchester Corporation's Rivers Department, on "Water Purification and Sanitation"; and Prof. Barger on "Fine Chemicals, Medicinal Substances, and Essential Oils." It will be seen that in all cases the editor has been fortunate in securing the co-operation of recognised authorities in the particular sections entrusted to them.

The remaining sections have been undertaken by previous contributors. Prof. Morgan continues his admirable series of reports on "Colouring Matters and Dyes"; Mr. Briggs deals with "Fibres, Textiles, Cellulose, and Paper"; Mr. Higgins with "Bleaching, Dyeing, Printing, and Finishing"; Dr. Auden with "Acids, Alkalis, Salts, etc."; Mr. Rees with "Glass and Refractories"; Mr. Bannister with "The Metallurgy of Iron and Steel"; Mr. Patchin with the "Non-ferrous Metals"; Mr. Hale with "Electro-chemistry"; and Messrs. Revis and Bolton with "Fats, Oils, and Waxes."

There is much in this excellent series of digests of general interest, and had space permitted we should have been tempted to direct attention to many points of novelty and importance. Certain of the sections overlap to a slight extent, and, as might be anticipated when we are dealing with matters at the very frontiers of progress, authorities occasionally differ, as, for example, concerning the importance or otherwise of the presence of vitamines in certain articles of food, as in margarine. But these reports are, or should be, generally accessible to all who are concerned with the multifarious applications of chemical knowledge, and the price at which they are issued brings them within the reach of all who are interested in the progress of applied chemistry.

(3) Mr. Carlton Smith's little monograph on the nitrotoluenes is, like its subject, a product of the war. Its author is on the staff of the School of Applied Science of the Pittsburgh Carnegie Institute of Technology. The book is mainly concerned with the history, modes of manufacture, and properties of the trinitrotoluenes, and particularly of T.N.T., which, under the various names of trolyl, tolite, trilite, trinol, tritolo, etc., is now largely used as an explosive in war by practically all nations in substitution for picric acid. During the late war the demand for it was enormous, and large quantities of it were made by American manufacturers on account of the high price it commanded. Mr. Smith's book is mainly concerned with the methods of production as carried on in the United States. It is presumably written for the information of the manufacturer; as a scientific treatise it has few merits; the explanation of the theory of nitration is confused and misleading, and the historical account is incomplete. Literary composition is evidently not the author's strong point, and his orthography and punctuation are occasionally erratic. For Walters (p. 6) read Walter; for Hoffman (p. 7) read Hofmann; for Rosenstill (p. 12) read Rosenstiehl; for Lamprицht (p. 16) read Limpricht; for Nolting and Witte (p. 16) read Noelting and Witt; for Astro-

misslewsky read Ostromisslensky. "Roberite" (p. 108) is usually written "roburite"—at least on this side of the Atlantic; and "Anallen" in the list of references should be "Annalen." These are blemishes which should not occur in a book written by an instructor in general chemistry in so important a school as the Carnegie Institute of Technology.

THE PRINCIPLES OF RADIO-COMMUNICATION.

The Principles of Electric-wave Telegraphy and Telephony. By Prof. J. A. Fleming. Fourth edition, revised. Pp. xvi+707. (London: Longmans, Green, and Co., 1919.) Price 42*s.* net.

IT is no easy task to keep a large treatise on electric wave telegraphy and telephony abreast of the advances that have been made during the last few years. In this fourth edition the author has been very successful. He does not load up the book with descriptions of all kinds of technical apparatus, or attempt to describe all the methods used in practice. There is now quite a small library of highly technical works which give the required detailed information to the engineer, and to these Prof. Fleming refers the reader. What he does give is a comprehensive view of the subject, particularly on its scientific side. He also dwells fully on quantitative measurements and their theory, which he himself has done so much to develop.

In part i. a discussion is given of electrical oscillations. The mathematical proofs given are rigorous and straightforward, and will be appreciated even by those who are beginning to forget their knowledge of the calculus. The mathematical formulæ for the high-frequency resistance and inductance of circuits are given, and the author's successful experimental methods of testing these formulæ described. When the wires are curved, the mathematical difficulties in the way of computation are so great that engineers will welcome the experimental verification of the formulæ.

The tables given of spark-voltages between spherical electrodes are somewhat antiquated. The reviewer had occasion recently to analyse the experimental results on spark voltages published in the standardisation rules of the American Institute of Electrical Engineers (1918). The Institute used spheres varying in diameter from 3.125 cm. up to 50 cm., and the spark voltages go up as high as 400 kv. The results plainly show that when the voltages of the electrodes are equal and opposite at the instant of discharge, the maximum electric stress, R, at this instant, the temperature being 25° C. and the pressure 76 cm., is given by

$$R=27{\cdot}4+14{\cdot}1/\sqrt{a}$$

kilovolts per centimetre, where a is the radius of either spherical electrode in centimetres. It was of interest, therefore, to see whether the results (p. 188) obtained by Heydweiller in 1893 on spheres of 0·5, 1, 2, and 5 cm. were in agreement with this formula. We find that when we correct for temperature and pressure they are in most excellent agreement. It follows, therefore, that if V be the spark voltage when the distance between the electrodes is x, we have

$$V=(R/f)x,$$

where f is a mathematical factor depending on x and a, a table of the values of which is given on p. 145 of this book. This is at least true for spheres varying in diameter from 0·5 up to 50 cm., values of x less than about a millimetre being excluded. Various theories have been given to explain why R should be the sum of two terms as shown above, but in the reviewer's opinion those theories which neglect the effects of the convection currents of air flowing round the electrode prior to the discharge are wrong.

In part ii. electric waves are discussed, and a very complete account is given of methods of measuring and detecting them. The remainder of the book is devoted to radio-communication. It begins with a short history of the subject. Then various long-distance telegraphic stations are described, the salient points of the systems of working being pointed out. The theory of transmission is given. Full descriptions are given of several of the latest developments of the art, such, for instance, as the Marconi military set for wireless apparatus, and the Marconi sets used in aircraft.

The final chapter treats of radio-telephony, and is perhaps the most interesting in the book. It is extraordinary what rapid progress is being made in this branch of the subject, and how different are the methods employed by the various experimenters. Marvellous results have been obtained by the Fleming oscillation valve. The almost incredible sensitivity attained in receiving apparatus by the use of thermionic amplifiers warrants the most sanguine hopes for the future of radio-telephony.

We ought to mention that, although additions have been made to the book to bring it up to date, yet by the deletion of antiquated matter and the use of smaller type the total bulk of the volume has been reduced. This is an advantage, as the earlier editions were beginning to get unwieldy. We can recommend this book to everyone interested in radio-telegraphy. To the scientific radio-telegraphist it is a necessity.

A. RUSSELL.

GEOGRAPHICAL ASPECTS OF WORLD POLITICS.

Democratic Ideals and Reality. A Study in the Politics of Reconstruction. By H. J. Mackinder. Pp. 272. (London: Constable and Co., Ltd., 1919.) Price 7*s.* 6*d.* net.

THERE is no lack of ideas in this book. From beginning to end it is full of striking conceptions which arrest attention even if some of

them fail to meet with acceptance. Mr. Mackinder has exercised to the full his ability to see the broad issues of history in terms of geographical influences, and he has produced a fresh and stimulating commentary on the world politics of to-day. Seeking fundamental generalisations, he sees a world-island comprising Europe, Asia, and Africa, and a heartland covering all continental as opposed to coastal Asia and European Russia. As the world-island is the base of sea power, so the heartland is the home of land power. In the antagonism between the two—that is, between German and Slav—Mr. Mackinder sees one of the fundamental causes of the war. There was no immediate quarrel, he contends, between East Europe and West Europe. Germany's object was to gain control of the heartland, and if she had thrown her main strength against Russia and stood on the defensive towards France, this aim, he thinks, might have been achieved before the peoples of the West realised its strategical danger.

The issue between German and Slav is still unsettled, and the danger of German control of the heartland still remains. To obviate this danger a balance must be held between German and Slav in East Europe. Certainly there is no indication that German psychology has undergone any change by the defeat of Germany in the West, and it might well be argued that the Allies' victory marks merely a respite in the world-war. Severe as are the terms imposed on Germany, her economic resources will eventually lead to her complete recovery, and her old ambitions may be reborn. Mr. Mackinder's solution of the problem is to break up Eastern Europe into self-governing States, so that there is a tier of independent States between Russia and Germany. Poles, Bohemians, Hungarians, Southern Slavs, Rumanians, Bulgars, and Greeks are each, he believes, people with the capacity for a strong independent national existence and capable of self-government. That is possible, but at the same time it is equally possible that such buffer-States, if weak, might become bones of contention and eventually lead to war on a large scale. It should be added that the volume was written last winter, and so is in no sense a criticism of the Peace Treaty.

OUR BOOKSHELF.

The Annual of the British School at Athens. No. xxii. Sessions 1916–1917, 1917–1918. Pp. vii + 272 + xi plates. (London: Macmillan and Co., Ltd., n.d.) Price 25*s*. net.

THE most interesting paper in this valuable review is that by Mr. E. Norman Gardiner on "The Alleged Kingship of the Olympian Victor." Two theories have been suggested to explain the origin of the Olympian games: one, that they were derived from funeral games held in honour of Pelops; the other, that they represent a ritual contest for the throne. As regards the first, the writer points out that the evidence in its favour is not to be found in any theory of the origin of funeral games in general, but in the fact that such games are of very early date, earlier than Homer, and reaching back to Achæan or Dorian times. The real objection to the funeral theory is that it does not explain any of the peculiar features of the Olympic festival, and that the evidence for it is inadequate.

The second theory depends on the supposition that the victor received honours regal and divine, such as riding in the chariot of the sun-god, being crowned with an olive wreath, like Zeus, and being pelted with fruit and flowers, like a tree spirit; and that hymns were sung and statues erected in his honour. Mr. Gardiner shows that these marks of honour will not bear the suggested explanation. "Students of religion are," he says, "apt to exaggerate the importance of the religious motive to the neglect of equally important secular motives." Athletic sports are already fully developed in Homer, the natural recreations of a race the business of which was fighting. In historical Greece they are naturally associated with festivals, held in times of holiday and peace, when the people met in friendly union.

Another important paper is that by Mr. F. W. Hasluck on "The Mosques of the Arabs in Constantinople," in which it is shown that the two so-called "Arab" mosques do not go back to the early date attributed to them, and that the Arab saint is often the successor of the Arab or negro Djinn well known in the folklore of the Nearer East.

An Introduction to the Study of Science: A First Course in Science for High Schools. By Wayne P. Smith and Edmund Gale Jewett. Pp. xi + 620. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 7*s*. 6*d*. net.

IN the presentation of their subject the authors have followed "the psychological rather than the traditional logical or dogmatic method"—as the preface puts it. The principles of science have to be looked for in the text or verified in the laboratory by the young student for whom the book is written. There is little doubt that when they are discovered they will make a far stronger appeal to his intelligence and his memory than if they were thrust upon his unwilling attention in the traditional manner.

The bearing of science upon human life and activities is kept constantly in view. The first chapter is about weather, the last, about the protection of health; and a quarter of the book is devoted to biological problems. The purist in science may find points at which to cavil, but the authors have run the risk of that, and are to be congratulated on writing a book which is within the scope of those for whom it is intended and can be read with profit and pleasure by the young.

Most of the illustrations are taken from the United States, for the book is intended primarily for students in the schools of that country. Another disadvantage, for English boys and girls,

is that the spelling is American. "Sulfur dioxid" looks strange in print. But teachers on this side of the Atlantic have much to learn from America in the way of presenting science informally, and they may be willing to overlook these minor points.

Manual of Vegetable-garden Insects. By Cyrus Richard Crosby and Mortimer Demarest Leonard. Pp. xv+391. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 12s. 6d. net.

IN this "Rural Manual" the authors give clear and concise accounts of the insects which, in North America, may be regarded as pests on vegetables grown in gardens. Each chapter is, as a rule, assigned to a particular species or group of vegetables, but "cutworms" (Noctuid caterpillars), blister-beetles, and flea-beetles are treated respectively in three special chapters, while another chapter is devoted to "unclassified pests." Most of the insects described are distinctively American species, but some—such as the cabbage-fly (*Phorbia brassicae*)—are common in British and European gardens. It is interesting to notice that in several cases an American insect attacks a cultivated plant in a manner like that adopted by an allied insect in Europe with the same plant; for example, the caterpillars of *Hydroecia* (*Papaipema*) *nitela* and *H. cataphracta* bore potato-stems, as those of *H. micacea* and *H. ochracea* do in these countries, while the damage by the American potato flea-beetle (*Epitrix cucumeris*) to foliage is closely comparable with that of our *Psylliodes affinis*.

The authors give a useful concluding chapter on the structure of insects, with special reference to their modes of feeding, this subject naturally leading to a consideration of insecticides. The book is illustrated with a number of well-drawn figures supplemented by photographs somewhat unequal in execution.

G. H. C.

Fauna Brasiliense. Peixes. Archivos do Museu nacional do Rio de Janeiro, vol. xvii. (Rio de Janeiro: Papelaria Macedo, 1915.)

THE bulky volume under notice contains a monograph, illustrated with excellent photographic plates, of the physoclistous fishes of Brazil by Prof. A. de Miranda Ribeiro, brought out in parts from 1913 to 1915. It is well got up, but the contents will be difficult to quote, as there is no continuous pagination and the numerous plates are not numbered. The classification and nomenclature are in accordance with the views of modern American ichthyologists; it is, however, a matter for regret that no sort of synonymy, not even a reference to the original descriptions of the species, should have been given, as by this omission the value of the monograph is greatly impaired, correlation with standard works of older date being thus rendered extremely difficult.

It is well that attention should be directed to this work, as only a part of it has been quoted in the "Zoological Record," no mention of it, or of the new species therein described, having appeared in the Reports for 1914, 1915, or 1916.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Labour and Scientific Research.

ENCLOSED is a copy of a resolution which has just been unanimously adopted by the American Federation of Labour at its Atlantic City convention. I trust that you may consider this of sufficient interest to the readers of NATURE to warrant its publication.

P. G. AGNEW.

Scientific and Technical Branch, Federal Employees' Union, No. 2, National Federation of Federal Employees, Washington, D.C., June 28.

"Whereas scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining, and others, must rest; and

"Whereas the productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology, and geology, in engineering and agriculture, and in the related sciences; and the health and well-being not only of the workers, but of the whole population as well, are dependent upon advance in medicine and sanitation; so that the value of scientific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and

"Whereas the increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase, since there is a limit beyond which the average standard of living of the whole population cannot progress by the usual methods of readjustment, which limit can only be raised by research and the utilisation of the results of research in industry; and

"Whereas there are numerous important and pressing problems of administration and regulation now faced by Federal, State, and local governments, the wise solution of which depends upon scientific and technical research; and

"Whereas the war has brought home to all the nations engaged in it the overwhelming importance of science and technology to national welfare, whether in war or in peace, and not only is private initiative attempting to organise far-reaching research in these fields on a national scale, but in several countries governmental participation and support of such undertakings are already active; therefore be it

"Resolved, by the American Federation of Labour in convention assembled, that a broad programme of scientific and technical research is of major importance to the national welfare, and should be fostered in every way by the Federal Government, and that the activities of the Government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the secretary of the Federation is instructed to transmit copies of this resolution to the President of the United States, to the President *pro tempore* of the Senate, and to the Speaker of the House of Representatives."

Behaviour of a Cuckoo.

A PAIR of pied wagtails built their nest beneath the crest-tile at the end of the roof of a cowhouse. The entrances to the nest were two, one at the gable end where the mortar was loose, the other on the roof itself beneath the tile. On June 24, at 5.30 p.m. (G.M.T.), a female cuckoo circled round the building, and presently, settling beneath the crest-tile, attempted to effect an entrance through the larger opening. But the opening was too narrow, and the bird could not force its body in beyond the shoulders. It therefore flew away and settled upon an adjoining building, but, returning in less than a minute, made a further attempt and failed again. These efforts were repeated a number of times without success. Two attempts were then made through the smaller opening on the roof, which, of course, also failed, and so the bird returned to the main opening and made still further and more determined efforts to enter, and the impulse to attain its end seemed to be increasing gradually in strength.

At 6 p.m. the bird betrayed symptoms of distress; its bill was often widely opened, and its efforts were more frequent and more prolonged. At 6.10 p.m. a final attempt was made; turning upon its side, it tried to force or scratch its way through the aperture, as a terrier forces its way down a rabbit-hole, but still it could not enter beyond its shoulders. A strange thing then happened. In addition to its muscular efforts there were distinct signs of emotional manifestation; its wings were spread and waved and its tail was outspread, and at the height of this manifestation the egg was protruded through the vent and fell to the ground. All excitement forthwith vanished, and the bird flew away and did not return. The emotional manifestation, similar to that which occurs so frequently in bird-life during sexual emotion, evidently coincided with the violent contractions of the cloacal walls.

There is a deal of evidence to show that the cuckoo sometimes lays its egg upon the ground, and then picks it up in its bill and deposits it in the nest, and sometimes actually lays it in the nest. Here we have a case in which, one would think, the former method would have been employed; yet there was no mistaking the fact that the activities of the bird were dominated by a single impulse, the impulse to enter the nest. Do some cuckoos employ one method and some the other; and is there a relationship, determined by racial preparation, between the mode of behaviour and the type of nest selected? If these questions can be answered in the affirmative, must this particular cuckoo be regarded as a prospective failure in the inevitable struggle for existence? H. ELIOT HOWARD.

Hartlebury, June 26.

Sparganophilus: A British Oligochæt.

BENHAM created the genus Sparganophilus in 1892, and gave a description of a new worm found at Goring-on-Thames, under the title *S. tamesis*. Since that time other species have been added to the genus, but no one has been able to confirm, extend, or confute Benham's statement that it was "a new English genus of aquatic Oligochæta" (*Q.J. Micr. Sci.*, N.S., 34, 1892–93, p. 155).

Looking over my collections to-day, I have had the good fortune to find some well-preserved specimens of Sparganophilus collected in Cornwall in April, 1910. I noted the worm at the time, and recorded it provisionally as *Helodrilus elongatus*, n.sp. Until now it has been hidden away and forgotten.

The Cornish species differs from that found in the Thames in several ways, and resembles somewhat closely *S. eiseni*, Smith, found in America, and *S. benhami*, Eisen, from Mexico. At present I look upon it as a new species, and propose to retain the trivial name already applied to it, and describe it as *S. elongatus*. It is nearly twice as long as *S. tamesis*, has from 200 to 250 segments, and is destitute of a pygidium. The anus is not dorsal, but agrees in position with that of the earthworm. The girdle also is longer, extending over segments 15–27, but I have only once been able to find any traces of tubercula pubertatis. HILDERIC FRIEND.

"Cathay," Solihull, July 9.

The Brent Valley Bird Sanctuary.

THE Brent Valley bird sanctuary of the Selborne Society has been carried on for sixteen years, and, apart from the experimental work which has resulted in the sending of nesting-boxes all over the country and to different parts of the world, much pleasure has been given to very numerous visitors of all classes. The committee has, until recently, been able to keep things going on the profits obtained from the sale of nesting-boxes, together with occasional donations.

The war upset all arrangements, and turned the balance in hand in 1914 into one due to the secretary, so that it has been found necessary to make an appeal for direct contributions. These may be sent to me at "The Hermitage," Hanwell, W.7, together with orders for nesting-boxes.

With a greatly increased amount of land under cultivation, and in view of the Government's afforestation scheme, the need for augmenting the number of insect-eating birds is manifest, and the importance of bird sanctuaries greater than ever.

In these circumstances it may not be out of place to express the hope that someone may come forward and put the Brent Valley bird sanctuary upon a permanent basis. WILFRED MARK WEBB, Chairman.

83 Avenue Chambers, W.C.1.

THE STRUCTURE OF THE SOLAR ATMOSPHERE.

SOME of the extraordinary revelations of the spectroheliograph, in its application to the structure of the solar atmosphere, may be gathered from the accompanying photographs, which have been courteously placed at our disposal by Prof. G. E. Hale, director of the Solar Observatory at Mount Wilson, California.

As is now well known, the spectroheliograph yields monochromatic images of the sun in light of any desired wave-length, and shows the distribution of the clouds of hydrogen, calcium, or other vapours, which are not apparent in direct observations by the integrated light. Further, by a suitable adjustment of the second, or isolating, slit of the instrument, different portions of the same spectral line may be separately transmitted to the sensitive plate, and the structure of the solar atmosphere at different levels above the photosphere may thus be investigated. In recent years the red line of hydrogen, $H\alpha$, has been largely utilised, and the photographs obtained with the central portion of this line are believed to represent the highest levels at present attainable. The work at Mount Wilson has been carried on for several years with a spectroheliograph of 5 ft. focal length, but during the last few years

a new instrument having a focal length of 13 ft. has also been employed.

Fig. 1 is a typical photograph showing the whole of the sun's disc when the second slit is reset on the centre of the Hα line. By comparison with Fig. 1a, which is an ordinary photograph of the sun taken at the same time, it will be seen that, in addition to the granulation over the general surface, there are both bright and dark "flocculi" in the vicinity of the various spot groups, and numerous dark markings in other parts of the disc. It is now generally agreed that both the bright and dark flocculi represent prominences in projection on the disc, the bright areas corresponding with bright eruptive prominences, and the dark ones representing masses of gas at the highest levels, where the temperature is so reduced as to cause the hydrogen to show its presence by absorption. This view has been strongly supported by the stereoscopic examination of pairs of photographs taken at intervals of about 7 mins., in which absorption markings have appeared as high ridges. The long, dark flocculi, which have been called "filaments" by Deslandres, are therefore now regarded as long ranges of prominences at a high elevation, but it is probably only the denser prominences which reveal themselves in this way.

FIG. 1.—Slit on centre of Hα, 5-ft. spectroheliograph, August 12, 1917.

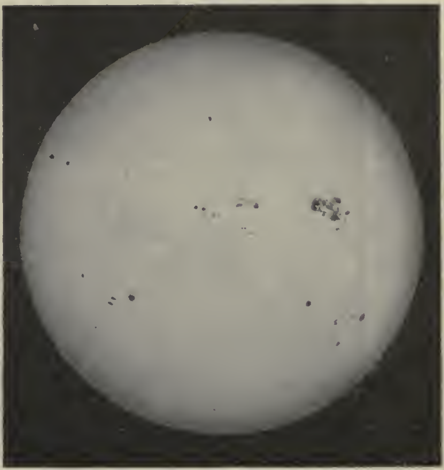


FIG. 1a.—Ordinary photograph of the sun, August 12, 1917.

The wealth of detail in such photographs can only be properly appreciated by suitable magnification of the original negatives, as in the other examples reproduced. Fig. 2 is an interesting case, showing several conspicuous prominences as absorption markings, and the generally disturbed state of the solar atmosphere in the region surrounding a group of sun-spots.

The small flocculi which appear all over the sun's disc have been carefully studied by Prof. Hale, who finds a general correspondence with the granulations of the photosphere which are familiar to all observers of the sun (Proc. Nat. Acad. Sci., Washington, vol. ii., p. 95). The coarse "rice-grains" of the solar disc were resolved by Langley into clusters of minute and intensely bright granules, not more than 0·3″ (about 135 miles) in diameter, and Langley regarded these as the upper extremities of long, thin filaments which exist vertically all over the sun, and are revealed more completely in the

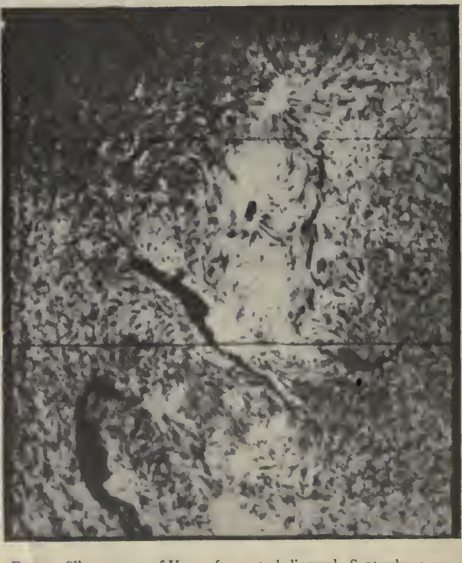
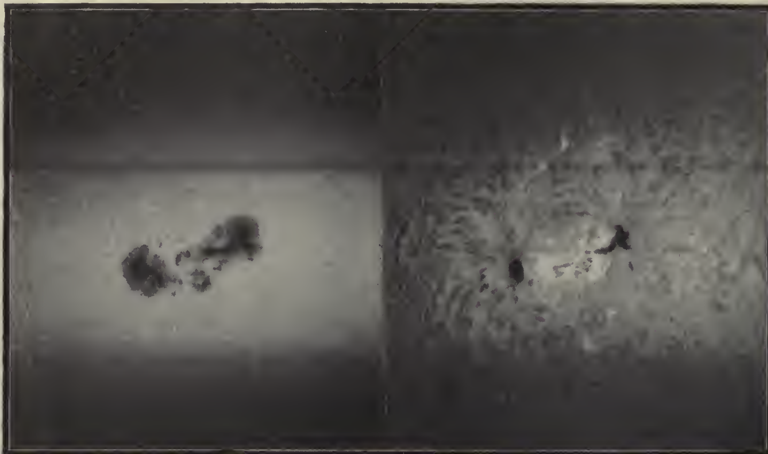


FIG. 2.—Slit on centre of Hα, 13-ft. spectroheliograph, September 9, 1915.

penumbræ of sun-spots, where they are drawn out nearly parallel to the solar surface. It was further supposed by Secchi that these photospheric granules were closely related to the radial filamentary structure of the chromosphere, and this relation is strongly supported by the results obtained for the cross-sections at different levels with the spectroheliograph. Photographs in low-level calcium (H_1 or K_1) correspond with a level somewhat below that observed visually at the sun's limb, and here the granules are relatively small. At the higher level represented by the H_2 and K_2 lines, the structure is generally similar to that of the photosphere, but the average size of the small, bright flocculi is rather greater than that of the granules found by Langley. At the still higher levels depicted when the second slit is set on the centre of Hα, the corresponding granules are dark, and the smallest of them are about 2″ in diameter, or twice the size of the smallest calcium flocculi. The filaments thus appear to expand as they rise, and Prof. Hale considers that these observations support the view that the photosphere and the gaseous atmosphere above it are formed of columns of hot gases, rising by convection from the interior of the sun. In order to explain the change from the continuous spectrum of the photosphere to the bright-line spectrum of the chromosphere, it seems necessary to suppose that precipitation of refractory materials occurs at the photospheric level, or that the conditions may be such as to cause the gases to emit a continuous spectrum.



a *b*

FIG. 3.—Bi-polar spot group. (*a*) Slit on portion of continuous spectrum; (*b*) slit on centre of Hα, 13-ft. spectroheliograph.

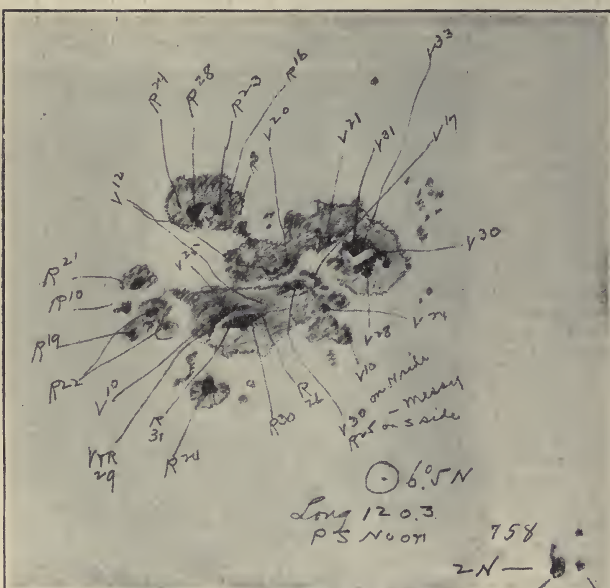


FIG. 4.—Record of magnetic polarities and field-strengths in different parts of a spot group, August 10, 1917.

In many cases, as shown in Fig. 3, the small, dark hydrogen flocculi surrounding spots present a well-defined vortex structure, and it is now well known that the hypothesis which associates a sun-spot with an electric vortex has been brilliantly confirmed by Prof. Hale in the discovery of Zeeman effects in sun-spot spectra corresponding with the magnetic field produced by the whirling ions. A large percentage of sun-spots are double, and the two members have been found to be of opposite polarity, as indicated by the polarisation phenomena of the components of the complex lines produced in spot spectra by the magnetic field, and by the opposite direction of whirl over the two component spots. Such groups are called bi-polar groups. In the case of Fig. 3 two isolating slits, side by side, were employed; one was set on a portion of the continuous spectrum, and thus shows practically an ordinary image of the spot group, while the other was adjusted to the middle of Hα so as to bring out the structure of the overlying atmosphere. The two photographs were obtained simultaneously in this way.

The polarities of sun-spots have been extensively investigated by the Mount Wilson observers, and arrangements have lately been made for the rapid *visual* determination of the polarities and field-strengths of all sun-spots as part of the daily programme of observations. The 150-ft. Tower telescope, giving a 16-in. image of the sun, and the 75-ft. spectrograph, with a compound quarter-wave-plate placed over the slit, are utilised in these observations. The method of recording the phenomena is shown in Fig. 4, representing a bi-polar group observed on August 10, 1917. In this diagram, R means that a given strip of the compound quarter-wave-plate, used with a Nicol prism, transmits the red *n* component of the Zeeman triplets, of which λ 6173 is selected for observation, and the appended figures indicate the

a b c d

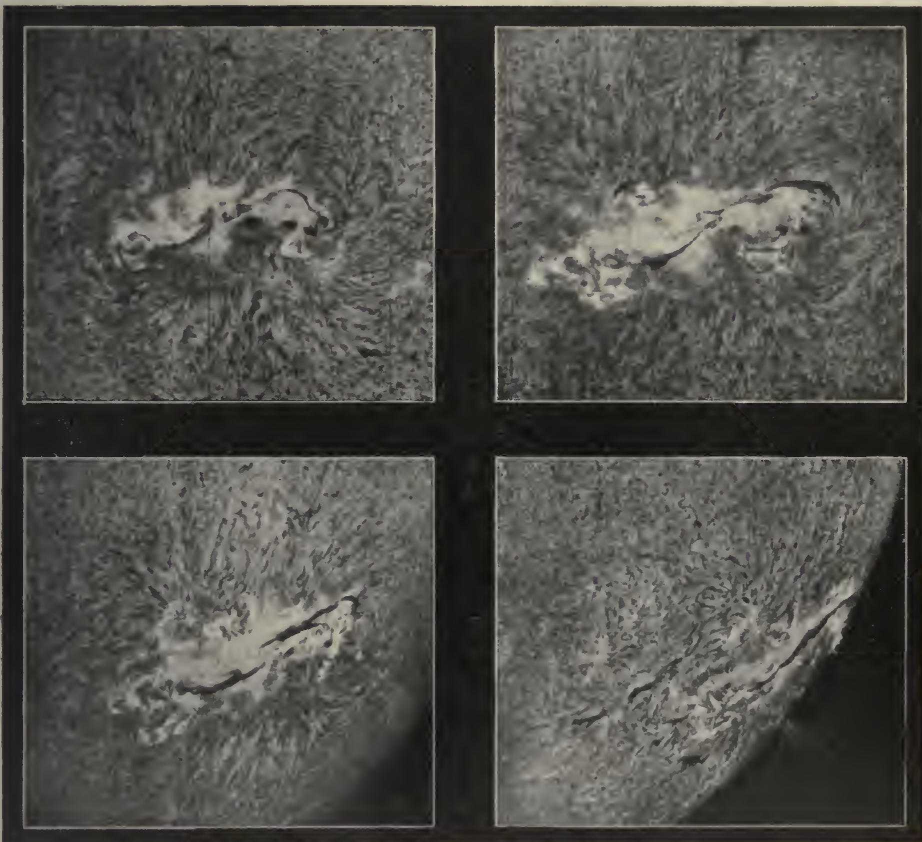


FIG. 5.—Hydrogen flocculi surrounding a group of sun-spots. (*a*) 1915, August 3; (*b*) August 5; (*c*) August 7; (*a*) August 9, 13-ft. spectroheliograph.

intensity of the field, at the point marked, in hundreds of gausses; R 21, for example, refers to a field-strength of 2100 gausses. V similarly means that the violet n component is transmitted, indicating an opposite polarity.

It has been found that the preceding members of bi-polar groups in the northern and southern hemispheres are of opposite polarity, indicating opposite directions of the whirling motion, as in the case of cyclones in our own atmosphere. There was a reversal of the polarities of the preceding members of the groups in the two hemispheres after the sun-spot minimum of 1912, and the polarities of spots would therefore seem to be connected intimately with the underlying cause of the sun-spot cycle (Proc. Roy. Soc., A, vol. xcv., p. 235).

Fig. 5 represents the successive appearances of a group of spots at intervals of two days, as it passed from near the central meridian towards the western limb. These photographs show a striking resemblance to Langley's drawings of sun-spots and the photosphere, and Prof. Hale considers that the resemblance can scarcely be devoid of significance, though the small hydrogen flocculi are somewhat larger than the minute grains of the photosphere. At some distance from the spot group it will be seen that the granules are replaced by slender filaments extending towards the axis of the group, recalling the penumbral filaments as they extend towards the umbra in the case of a sun-spot. These filaments stop abruptly at the edge of a bright region of honeycomb structure, from the middle of which the long, dark flocculus is seen to rise as a high ridge when viewed in the stereoscope. The dark flocculus itself appeared as a bright prominence when it was brought to the limb by the sun's rotation.

While the principal features shown in the photographs obtained with the spectroheliograph may now be considered to have received a satisfactory interpretation, it will be evident that the photographs include a vast amount of material for further research on such questions as those referring to the dimensions of the columns of ascending gases, and the movements of the vapours around and above the sun-spots.

PROF. EMIL FISCHER, FOR.MEM.R.S.

THE death of Emil Fischer will be deeply regretted throughout the world of chemists; his achievements alone suffice to belie the attempts too frequently made of late years, during the war, by speakers in no proper way conversant with the subject, to belittle German scientific performance and originality. No act is so dangerous as that of underrating the intelligence of an enemy: but this we persistently did in the past, notwithstanding the warnings that were given by those few who were alive to the facts; and this we are boastfully doing at the present, before we have made any effective progress in overcoming the difficulties by which we were hampered in the past and while we are still almost leaderless and unorganised.

Emil Fischer was one of Germany's great academic experts—a man who was listened to and used by his Government and supported in every necessary way; he was simply worshipped by industry. We can but envy the position he enjoyed. Our Government has still no use for the expert; indeed, the Board of Trade has officially declined, only recently, to give academic chemical science any voice in connection with so ultra-chemical a subject as the dyestuff industry —an industry which is simply the laboratory writ large; and the industrial worker still too often scoffs at the academic worker instead of treating him as his boon companion—perhaps sometimes with show of reason, as the latter is apt to get on stilts.

When the present writer first met Fischer in Strasburg in January, 1882, he all but fell in love with him on the spot. A Rhinelander, tall, well-built and well-dressed, with eyes of wonderful brightness and manners of most engaging frankness and courtesy, Fischer had scarcely any of the attributes of the pedagogue, although, as years went on and he grew in importance, his impatience with those who ventured to question his opinion became more obvious—but no German can escape from this. If not the prototype of a new academic genus, Fischer was certainly a mutant of the original German species. A far greater chemist than his predecessor, Hofmann, he lacked Hofmann's diplomatic qualities and love of influence; and though he filled his office with dignity and distinction, he in no way courted publicity; indeed, for the most part he lived the austere life of the recluse, spending his time, other than that given to necessary official duties, entirely either in his laboratory or in his study. He systematically overworked himself and there is little doubt that his frequent complaints of his health—of his *Magen* particularly—were largely conditioned by overwork. No chemist has secured success to a greater extent through constantly enforced intellectual effort and the determination, having once conceived an object, to win through. He was a striking contrast, in this respect, to his wonderfully alert contemporary, Victor Meyer, in whom the faculty of immediately seeing and seizing an opportunity was perhaps more highly developed, though he had neither the fixity of purpose nor the patience of his colleague; but Meyer was a Jew, hence the difference. The two men made parallel discoveries, almost at the same time, the one by developing the use of phenylhydrazine, the other that of hydroxylamine, as differential analytical agents: but phenylhydrazine became the Rosetta stone with the aid of which Fischer unlocked the story of the sugars and justified Pasteur's prediction that life is an asymmetric process.

It is impossible to overrate the value of the three great series of investigations which are inseparably linked with Fischer's name, as, by his work on the Sugars, on the Proteins and on Uric

derivatives (each an inquiry of unparalleled magnitude and importance), he made biology, on the chemical side, a science.

Fischer appears to have continued to exercise his academic activity throughout the period of hostilities, as communications bearing his name have been published at frequent intervals. It is difficult to imagine that he can have taken any part in the hellish work of war. The loss of such a man at such a time is greatly to be deplored, as he would probably have been one of the few to exercise an ameliorating influence. He died at the comparatively early age of sixty-seven.

Fischer received the Davy medal from the Royal Society in 1890 and was elected a Foreign Member of the society in 1899. He was awarded the Nobel prize in 1902. He had many competent English and American workers among his students, who rendered him no slight assistance. His laboratory has been one of the limited number in which, of late years, experience of real value, both technical and moral, could be gained; few men have set so high an example to their students and no one was more mindful in spirit of his countryman Kekulé's saying, "Nur keine unreifen Früchte." He would recommend no one who was not sufficiently trained. Many are now seeking entry into practice here who are not only under-trained but also unaware of their ignorance: herein lies our danger—we have yet to attach real meaning to the term "chemist" and to follow Fischer's example. As representative of the genus in its most highly developed modern form, he is to be placed at the very apex.

From the time of Liebig onward English students have visited German laboratories and these have undoubtedly afforded them valuable opportunities. But the Germans have also been gainers thereby and they have yet to realise what they lose by our withdrawal. The change of circumstances will be to our advantage in many ways. The object of higher training should be to promote originality and individuality, but instead of being trained on individualistic lines, of late years students in Germany have been led to worship authority rather than to be freethinkers.

A more serious consequence of the constant emigration of our students to German laboratories, however, was the effect this had in preventing the development of higher education in our own schools: until recently it rendered the systematic prosecution of chemical inquiry and the formation of schools of research in this country almost impossible. Our most capable workers were constantly withdrawn from us just as they were about to become valuable instruments—we were allowed to sharpen pencils but not to use them. In fact, we have allowed the Germans to monopolise not only the dyestuff industry but also the higher academic industry—and not only have our best students been encouraged to leave us but we have also done our utmost to sterilise the intellects of the remainder by a cast-iron system of examinations. The 1851 Commissioners, unfortunately, favoured this policy; indeed, at one time they almost forced their chemical scholars to go to Germany. As there was no interchange, we were left without helpers. The protests made as to the impolicy of the course were of no avail—we were told, in no halting terms, that we sought to keep students at home to serve as our assistants; yet the Germans were allowed to use them to their ends—in the eyes of our officials what was improper here was permissible abroad. Fortunately, during the past decade or two, we have been successful in gradually stemming the tide of emigration and our higher instruction has been developed apace, though hitherto it has never been otherwise than starved.

H. E. A.

NOTES.

THE Forestry Bill, which was brought up in the House of Lords early in the month, has now passed its third reading. The Bill is the first attempt at forestry legislation to be brought before Parliament since the question of afforesting some of the waste lands in the country was first mooted more than thirty years ago. During this period numerous Commissions and Parliamentary Committees were appointed to consider this matter, but no planting was undertaken as a result of their deliberations. It is the war, and the enormous demands for timber, especially the soft woods of the trade, entailed by it, which opened the eyes of the Government to the dangerous position in which Great Britain stood in the matter of timber supplies. The Government Bill now before the country is closely based on the recommendations made by the Forestry Sub-Committee appointed by the late Minister of Reconstruction. It proposes the appointment of a Forestry Authority of seven (reduced to five in the House of Lords) Commissioners and the afforestation of 1,750,000 acres in eighty years, a quarter of a million acres to be planted in the first ten years at a cost of 3,500,000*l*. The total cost of the undertaking will certainly be far greater than the estimates laid before the House, these estimates being very nearly pre-war figures. The Bill was introduced by the Earl of Crawford. It was opposed by Viscount Haldane, whose chief arguments were the danger of erecting an authority of the kind proposed, which would not be subordinate to any Minister; and possessed of funds drawn from the Consolidated Fund, and not, therefore, placed on the Estimates, and consequently far less open to effective criticism in Parliament. The main point brought out by Lord Haldane, the one really weak part of the Bill from the scientific point of view, is the inadequate manner in which provision is made for future educational and research work and for the representation on the Board of Commissioners of forestry experts possessed of a sound scientific training. In the matter of scientific training and knowledge the proposed Board of Commissioners is a purely amateur one. Unless means can be devised to set up a Board truly representative of what is required—a Board which shall include a strong representation of men provided with a sound scientific training and a wide practical knowledge of forestry conditions throughout the Empire—there is a grave danger that the objects the Bill seeks to achieve will be doomed to failure from the outset, with the resultant disappointment and waste of public funds.

WE regret to learn of the death, at seventy-five years of age, of Antoine Paul Nicolas Franchimont, emeritus professor of organic chemistry in the University of

Leyden. After graduating there in 1871 he worked with Kekulé at Bonn and with Wurtz at Paris, and was appointed in 1874 professor of organic chemistry in his native town. During forty years he trained many Dutch organic chemists, and on his retirement in 1914 chairs in the other three Dutch universities were in the occupation of his pupils. Besides being an enthusiastic teacher, Franchimont was an indefatigable investigator. His principal work was concerned with the nitro-amides, which he discovered in 1883, and the aliphatic nitramines ($R.NH.NO_2$). For the preparation of these compounds, often highly explosive, he introduced the use of pure ("real") nitric acid, prepared by distilling a mixture of nitric and sulphuric acids *in vacuo*. The use of sulphuric acid and of zinc chloride as catalysts in acetylation is also due to him. Although some of his results (acetylcellulose, pure nitric acid) found technical application, he derived no material gain from them. Of an unworldly and retiring disposition, Franchimont did not often frequent scientific congresses, but those who met him at the Cambridge meeting of the British Association in 1904, or visited him at Leyden, will cherish the memory of a kindly man who lived for his science and for his pupils. His family associations gave Franchimont a command of the French language, and he was one of the founders, in 1883, of the *Recueil des Travaux chimiques des Pays-Bas*, in which journal nearly all his subsequent work was published. Outside his native country his merits were recognised by his election to the honorary membership of the Chemical Society and by his appointment to the Legion of Honour.

On Wednesday, July 23, Mr. F. H. Carr, at a meeting of the British Pharmaceutical Conference, delivered a memorial lecture on the late Lt.-Col. E. F. Harrison, whose invaluable work on the development of the anti-gas respirator has lately been the subject of so much eulogy. No more fitting place could have been chosen for the lecture than the buildings of the Pharmaceutical Society in which Harrison received his training in the profession he had selected, and with which he was afterwards so intimately associated, nor could the delivery of a lecture in his memory have been entrusted to a better or more capable man than Mr. Carr. Most of the audience had been personal friends of Harrison's, some of them for upwards of twenty years, and they knew that the testimony that Mr. Carr bore to his sterling qualities, his upright nature, his sincerity, and the fearless manner in which he grappled with difficult problems, was only too well deserved. The details which Mr. Carr gave of Harrison's early life, his tenacity of purpose and remarkable self-denial, were interesting in the extreme, and went far to explain a certain austerity in his nature. The part which Harrison played in the final phase of his life, the development of the box-respirator, by which so many lives were saved and which contributed so largely to the victorious issue of the war, occupied the latter part of the lecture, which will long remain in the memory of those who were fortunate enough to hear it.

At the meeting of the British Association in 1914 a wish was expressed for some organisation by which the breeders of plants and animals and those engaged in genetical research might be brought into closer contact with one another. The advent of war prevented the immediate realisation of these hopes, but in the present year, largely through the energy of Miss E. R. Saunders, the Genetical Society has come into being under the presidency of the Right Hon. A. J. Balfour. It is expected that the society will be mainly peripatetic, holding meetings on convenient dates at places where breeding work of interest is in progress, whether at scientific institutions or plant nurseries or stock-raising centres. Open-air demonstrations offer considerable difficulties in the case of large parties, and for this reason it was held advisable to limit the number of members of the society to 120, and to impose certain qualifications for membership. Candidates for admission must either be, or have been, engaged in genetical research, in the teaching of genetics, or in the practical breeding of plants or animals. It is proposed also to hold meetings from time to time for the reading of papers and the discussion of results. It was appropriate that the society should enter upon its active existence with a visit to Cambridge, the cradle of modern genetic studies. Between thirty and forty members attended the meeting on July 12, at which Miss Saunders gave a lucid and interesting account of the present state of knowledge of the genetics of stocks. The members present visited the garden where these experiments have been in continuous progress since the end of last century. Prof. Punnett gave an account of some experiments with sweet peas designed to test the validity of the chromosome hypothesis of heredity, and Prof. Biffen demonstrated wheat material in connection with the inheritance of immunity and susceptibility to rust. Mr. J. B. S. Haldane also described some experiments with two new colour varieties of rats which have recently come into existence, illustrating his account with living examples. The secretaries of the society are Miss C. Pellew, The John Innes Horticultural Institution, Merton, S.W.19, and Prof. Punnett, Whittingehame Lodge, Cambridge, from either of whom further information may be obtained.

We regret to see the announcement of the death at Naini Tal, in his sixty-first year, of Prof. A. W. Ward, professor of physics at the Canning College, Lucknow. From a short obituary notice in the *Times* we learn that Prof. Ward was educated at Liverpool College and Institute, and at St. John's College, Cambridge, where he held a scholarship, graduating in 1882. After lecturing at the Borough Road Training College and working in the Cavendish Laboratory, he went out to Southern India in 1885 as lecturer on physical science at the Kumbakonam College, but was soon invalided home. He returned to India in 1889 to take up his Lucknow appointment. He was a prominent figure in all matters connected with the University of Allahabad as a member both of the Senate and of the Syndicate, and was its representative on the United Provinces Legislature. Prof. Ward contributed a number of scientific papers to the Proceedings of the Royal Society and to the *Philosophical Magazine*.

In the *South African Journal of Science* for 1918 (vol. xv., No. 6) the Rev. J. R. L. Kingon discusses "Cattle as a Factor in the Economic Development of South Africa." He considers the cattle question in relation to the Portuguese voyagers; the aborigines, including Bushmen, Hottentots, and Bantus; the Dutch; and the first British occupation, and shows that much of the history of the country is focused in its cattle. He leaves untold the story from the time of the second British occupation down to the present day, during which period the question has been of no less importance.

Seldom has a more elaborate monograph descriptive of a group of people numbering fifty-seven souls been prepared than that issued as vol. xlii., part i., of the Journal of the College of Science, Imperial University of Tokyo (R. Torii, "Etudes Archéologiques et Ethnologiques: Les Ainou des Iles Kouriles"). The author remarks that in all the

many accounts of the Ainu, those of the Kurile Islands have been strangely neglected, but that they form an important factor in the study of this remarkable people. This claim is fully justified by the appearance of this elaborate account of them, dealing with their history, linguistics, sociology, customs, and superstitions. It is illustrated by thirty-eight pages of photographs and by numerous drawings in the text.

IN Norway, as elsewhere, the little Scrophulariaceous plant Euphrasia, best known to us as the common eyebright, is extraordinarily variable. The numerous forms that have been described, notably by R. v. Wettstein, may be due in part to local influences, differences of moisture, and the like, and appear to revert to the norm when withdrawn from the action of such influences. Other forms seem to be more permanent, and may be definite mutations provoked by differences of climate in different districts or changes of climate in past time, or by other physical changes in the environment. Such forms may be regarded as true species or sub-species. Yet other forms are probably hybrids between those last mentioned, and, though of apparently constant recurrence, would be susceptible to Mendelian analysis. Before such analysis is undertaken it is certainly helpful to have a very exact systematic survey of all the variations that occur in a state of nature; and this is the task that has been accomplished for the Norwegian species by Mr. E. Jørgensen, whose results have just been published in Bergens Museums Aarbok, 1916–17 (Naturvidenskabelig Raekke, 2 Hefte, 337 pp., 11 maps, 14 pls., 1919). The main text, which is in German, is also illustrated by enlarged diagrams of detail, and there is an English summary. The author recognises five species, with sub-species, forms, and sub-forms, all belonging to the sub-genus Eueuphrasia, Wettst., section Semicalcaratæ.

LIGHT has been thrown upon a very fascinating theme by the publication of Dr. Gilchrist's paper on "Luminosity and its Origin in a South African Earthworm" (Trans. Roy. Soc. S. Africa, vol. vii., part 3, 1919, pp. 203–12, pl. xxiv.). We have but one regret: the species of Chilota which displayed the phenomenon in so marked a degree is not identified. So long ago as 1900 no fewer than thirty species had been described. Chilota is nearly related to Photodrilus, Giard, and one species of this genus is now known as *Microscolex phosphoreus* on account of its luminous properties. Until each species known to be luminous has been definitely determined, we shall always have confusion. But in regard both to the information given and to the inferences or conclusions drawn therefrom, Dr. Gilchrist's paper is a decided advance on its predecessors. Fungi, bacteria, gregarines, and other lowly organisms have been regarded as agents in the production of luminosity, and the author not only states the case as it formerly stood, but also gives a very clear and instructive view of his own observations and findings. The fluid exuded was subjected to a variety of tests, and found to consist mostly of single cells heavily laden with inclusions of different kinds. "The luminosity is given out by the inclusions of small size, and these seem to be of a substance allied to fat, by the oxidation of which light is produced."

THE Weekly Bulletin of the Hawaiian Volcano Observatory records in vol. vii., No. 1, for January, 1919, the very considerable appearance of "smoke" that may arise from incandescent lava owing to copious evolution of sulphurous gases. The bulletin continues to give admirable photographs of successive stages of activity in Kilauea.

MR. THOMAS SHEPPARD, well known for his researches and historic studies in British stratigraphy, has given an interesting account of "Martin Simpson and his Geological Memoirs" in the Proceedings of the Yorkshire Geological Society (vol. ix., p. 298). Simpson was well known to visitors in the classic surroundings of Whitby, and published a summary of the contents of the Whitby Museum at the age of ninety-one, a year before his death in 1892.

IN *Naturen* for April–May, 1919 (forty-fourth year, Nos. 4–5), Hr. Olaf Holtedahl gives a distinctly original series of maps showing the relations of land and sea "i jordens oldtid" in the North Atlantic region. The "oldtid" dealt with ranges from Ordovician to Permian times, and the maps, and the evidence discussed, include the whole North Polar area and that down to Newfoundland and the British Isles. The maps, if enlarged, would make an excellent series of lecture-diagrams.

THE literature of that old and recurrent subject, the origin of flint, is added to by Mr. W. H. Twenhofel in a paper on chert in Kansas and Oklahoma (*Amer. Journ. Sci.*, vol. xlvii., p. 407, 1919). The author refers to W. A. Tarr's work (see NATURE, vol. ci., p. 174), but does not seem to have considered the formation of flint-zones by deposition of silica in waters moving at right angles to the stratification. He assigns, at any rate for the region dealt with, an early date in the history of the unconsolidated rock for the growth of flint from silica in solution in the sea.

IN a paper recently received (Académie d'Agriculture de France, October 23, 1918) Prof. J. Mascart, the director of Lyons Observatory, has directed attention to the exceptional nature of the two winters 1916–17 and 1917–18 in that neighbourhood. Both produced cold spells of unusual severity, and the sequence of two such winters following one another appears to be almost unique. In the winter of 1916–17 the autumn might be said to be prolonged to January 15, after which, with two brief exceptions, temperature remained low until April 28, falling at times below -20° C. over extended regions. Thereafter the first fifteen days of May were very warm, so that the season of spring was entirely suppressed. The features of the following winter were very different; there was a cold spell from mid-October to mid-January, after which the weather became mild until the end of March, the break in January being of a very pronounced character. Thus the lowest temperature of the winter occurred on January 5, $-17{\cdot}1^\circ$ C., and the mean temperature of that day was $-11{\cdot}2^\circ$ C. On January 20 the mean was no less than $+11{\cdot}7^\circ$ C., or $22{\cdot}9^\circ$ C. above that of January 5. This difference is greater than that between the mean coldest and the mean warmest days of the year. Attention is directed to the fact that the two winters were almost inverse, so that mean temperature from the two combined would have shown little of note. In considering the effect of such winters on fruit-trees and crops the difficulty of eliminating other factors is pointed out, and it is suggested that close collaboration between agriculturists and meteorologists is necessary to arrive at any conclusion of value.

A VALUABLE article on the mechanical extraction of coir is published in the *Philippine Journal of Science* (November, 1918); also one on the mechanical properties of Philippine coir and coir-cordage. The same issue also deals with steaming tests of Philippine coals.

THE annual report of the Board of Scientific Advice for India, just to hand, gives a very comprehensive summary of the work carried out by the different departments for the year 1917–18. The section reports deal with applied chemistry, astronomy, meteorology, terrestrial magnetism, geology, geodesy, botany, agricultural bacteriology, forestry, zoology, veterinary science, and medical research.

THE first number of *Science and Industry*, the official organ of the Commonwealth Institute of Science and Industry, is just to hand. The aim of the new journal is to serve as an authoritative medium for the expression of Australian scientific thought and aspirations. Contributions are welcomed at the same time from all independent scientific workers. The object of the new institute is the co-ordination of scientific research in the Commonwealth. At present there is a paucity of trained scientific workers and much overlapping. The inaugural number contains articles and notes of primary interest to Australian industries, *e.g.* the prickly pear pest, the obligation of science to pastoral industry, applications of veterinary research, the artesian water problem, sheep-fly investigations, etc.

THE Journal of the Royal Society of Arts for July 4 contains a paper on science and industry in Australia, which was read by Sir John McCall, whose death on June 27 is so deeply lamented. The paper sketches the development of agriculture in the Commonwealth, and sets forth the hopes for the future, especially in view of what is being done to promote scientific research and study. Australia contains vast mineral resources, particularly coal and iron, and the manufacture of iron and steel should be greatly facilitated by the excellent metallurgical coke derived from the coal of New South Wales and Queensland. Now that the steel industry is established in the continent, it is expected that wire and tinplate manufactures will be greatly stimulated. In regard to more scientific manufactures also, progress has been made during the war, and, with further development, they should be capable of production at much lower prices than those at which they can be obtained from Germany.

DR. R. E. SLADE, director of research of the British Photographic Research Association, has presented a report upon work in progress or contemplated. A wide programme of research has been drawn up and preliminary experiments have been made on a large number of subjects. The history of photographic science and industrial development shows that, since the publication in 1891 of the researches of Hurter and Driffield, practically no new methods of attacking the problems of photography have been introduced. Many workers have improved and worked out further details of the old-established methods, and very considerable advances have been made, but the time now seems ripe for entirely new methods of photographic research. The association is using all the means at its disposal to initiate such new methods, and is making progress in this direction. Some experiments have been made on gelatin, which, though not suitable for publication, will be of great use in future work. Progress has been made in investigations of photographic emulsions, and a communication on this subject will be circulated shortly. Success has been attained in staining wood black or grey right through. This black wood, which was made in Germany before the war, is used by manufacturers of cameras and optical instruments, and the grey wood for picture-frames and furniture. The process, for which an application for a patent has been filed, should be suitable for use on a large scale, and also be economical. Results of research, whether theoretical or experimental, which are of general interest, and not of immediate use for application to specific problems of the industry, are published at the first opportunity to increase knowledge in photographic science generally, and to induce other workers to devote their attention to theoretical photographic problems. The offices of the association are at Sicilian House, Southampton Row, London, W.C.1, and the secretary is Mr. A. C. Brookes.

A NEW volume by Mr. E. H. Chapman will shortly be added to the Cambridge Nature Study Series, published by the Cambridge University Press. The title is "The Study of the Weather," and the aim of the book is to provide not only a series of practical exercises on weather study, but also a simple introduction to the study of modern meteorology.

MR. CHARLES BAKER'S current list of second-hand scientific instruments is now available for distribution. The catalogue gives particulars of more than 1500 pieces of apparatus which can be examined at 244 High Holborn, London, W.C.1. Mr. Baker holds a large stock of materials for colour photography, and can undertake the immediate delivery of standard material. Every instrument included in the list is guaranteed, and customers can, in certain circumstances, have pieces of apparatus for three days on approval before actually purchasing.

OUR ASTRONOMICAL COLUMN.

A WORLD SURVEY.—The Paris Bureau des Longitudes is proposing to make use of wireless telegraphy to determine the geodetic position of certain points on the earth's surface which shall be considered fundamental, and may be used as reference points for future geodesy. Triangulations have been made and arcs of longitude measured in different regions of the world which have been co-ordinated, but it is possible that the attachment of these may be improved. The closing error in the longitude of the sphere, or the amount by which the sum of the arcs circumscribing the earth differs from 24 hours, is about a fifth of a second of time. The details of the plan at present suggested are that Paris, Shanghai, and a third point in the neighbourhood of San Francisco shall be taken as primary points. The latitude of each is to be determined, possibly with the prism astrolabe, and the difference of longitude between each consecutive pair measured. It is suggested that the clocks at Paris and Shanghai may be compared by means of signals from the radio-telegraphic station at Lyons, those at Shanghai and San Francisco by signals from Honolulu, whilst signals from Annapolis would serve for the comparison of the clocks at San Francisco and Paris. This is the main feature of the scheme, to which subsidiary details will be added. It is proposed, for instance, that the position of a point in New Zealand, the antipodes of France, shall be determined, and naturally it is hoped that Greenwich will take part in the operations and form one of the points of reference.

SOLAR PHYSICS AT CAMBRIDGE.—The sixth annual report of Prof. Newall, the director of the Solar Physics Observatory at Cambridge, which relates to the year ending March 31 last, shows that the staff is returning after war service, and that one member only is absent, Capt. W. E. Rolston, who is with the Army in Cologne. The staple work of the institution is divided under three heads:—(A) Stellar work, which at present consists mainly of the classification of stellar spectra, and the arrangement of these in sequence in relation to the intensities of characteristic lines. (B) Solar work, the observational

part of this being done by the spectroheliograph, with which photographs of the sun's disc are taken in calcium light, and pictures of this kind were obtained on 111 days in the period under review. Similar spectroheliograms are received from Kodaikanal, and these records are studied at Cambridge for evidence of systematic distribution of flocculi. The third heading (C) is Meteorological Physics, which is represented by the work of Mr. C. T. R. Wilson on lightning discharges and the variations of potential of the electric field in thunderstorms.

THE SPECTRUM OF NOVA AQUILÆ.—Besides the work recorded in the preceding note, investigations have been made of the spectra of Novæ. Photographs of the spectrum of Nova Aquilæ (1918) were obtained very soon after the appearance of the star, and it is concluded from examination of these early photographs that the outburst was accompanied by changes in the spectrum which, if indicating motion in the line of sight, involve two or more pulses moving with exceedingly high velocity. A study previously made of the spectrum of Nova Geminorum (1912) showed that the narrow lines in the spectrum of that star resembled those of α Cygni. The complex absorption lines exhibited in the spectrum of Nova Aquilæ have been deciphered as being effects characteristic of α Cygni, but duplicated by two large displacements which agree with those of the simultaneously duplicated absorption lines of hydrogen.

THE BRITISH ASSOCIATION.

Provisional Programmes of Sections.

THE programme of sectional arrangements for the meeting of the British Association at Bournemouth on September 9–13 is well advanced, and many interesting subjects, both in connection with scientific work during the war and otherwise, will come up for discussion. Among these the following are provisionally entered :—The Mathematical and Physical Section will discuss the origin of spectra and thermionic tubes, and will receive reports or papers on the recent solar eclipse observations, on wireless telegraphy during the first three years of the war, and on wave-motion. A visit to the neighbouring Holton Heath cordite factory, with appropriate papers, has been arranged by the Chemistry and Engineering Sections. The Geological Section will concern itself specially with local geology, and will discuss jointly with the Anthropological Section the age of local antiquities. The Section of Zoology, among many other papers, provisionally announces afternoon lectures on grain pests and the storage of wheat, lice and their relation to disease, and the geographical distribution of fresh-water fishes. The Geographical Section purposes to discuss the geographical aspects of devolution, and, among other subjects, to receive papers on air photography, long-distance air routes, the geography of Imperial defence, the colonisation of Africa, and various frontier questions, if circumstances permit; it also hopes for a paper on geography from Sir Henry Wilson. The Economics Section announces a number of distinguished speakers on a national alliance of employers and employed, price-fixing (with special reference to Australian experience), transport, the gold standard, finance and taxation, the replacement of men by women in industry, and other subjects. The Engineering Section will pay special attention to aviation in various aspects. The Anthropological Section will receive a number of papers on the eastern Mediterranean region, on early prehistoric archæology, the ethnology of the Russian borders, cults, the migration of culture, etc. The Physiological Section will discuss jointly with that of Economics the influence of the six-hour day on industrial efficiency and fatigue. The Botanical Section will join the Zoological in receiving papers on the origin, evolution, and transmission of biological characters, with the Agricultural for the discussion of forestry problems, and with the Educational for that of the teaching of biology. The programme of the Educational Section includes the discussion of the free-place system, the teaching of English, the method and substance of science teaching, training in citizenship, continuation schools, private schools, museums, fundamental principles in education, and (jointly with the Economics Section) business in relation to education. The Agricultural Section, among various other topics, will receive a group of papers on war-time food production in Great Britain. Fuller details, with particulars as to membership of the association, may be obtained from the offices at Burlington House, W.1, or from the local secretaries, Municipal Buildings, Bournemouth.

CANCER RESEARCH.

THE annual general meeting of the Imperial Cancer Research Fund was held at the Examination Hall, Queen Square, Bloomsbury, on July 23, his Grace the Duke of Bedford, K.G., in the chair.

Sir William Church, Bart., proposed the adoption of the report, and gave a summary of the work of the fund during the war, both on cancer and on other subjects. The effect of withdrawing a large number of young males for military service was to alter the age-constitution of the civil population, producing an apparent great increase in the crude male death-rate from cancer. The female rate was unaffected, and the apparent rise for males disappeared when the necessary correction was made. The method of autologous transplantation had been used to separate tumour-like proliferations of lymphoid tissue from the true malignant new growths of mice. The former never grew on grafting into the affected animal itself, even when recurrence and dissemination occurred. Autologous grafts of true new growths were practically always successful, whether recurrence took place or not. Experiments were carried out on the relation of the water-content of tumours to their rate of growth. In harmony with the findings for normal tissues in animals and plants, the tumours showed a close relationship in this respect, the more rapidly growing tumours having the higher percentage of water. The water-content of tumours could be artificially reduced by exposure to isotonic calcium chloride solution *in vitro*, and such material on inoculation exhibited diminished powers of growth, from which recovery was slow but complete.

The work on war problems mentioned in the report dealt, first, with the heat-regulating mechanism of the body, especially the *rôle* played by the thyroid-adrenal apparatus, and its derangements in disease accompanied by fever or hypothermia. A second paper was devoted to the pathology of gas gangrene. It could be shown that a specific local injury of the tissues permitted the development of the anaerobic bacteria of gas gangrene and tetanus. Substances present in cultivated soil, particularly ionisable calcium salts, were able to produce the necessary lesion which breaks down the otherwise efficient natural defences against these micro-organisms. These two papers, and another on the fate of grafted cartilage, will shortly be published in the Sixth Scientific Report of the fund.

THE METALLOGRAPHY OF IRON AND IRON-CARBON ALLOYS.

AT the May meeting of the Iron and Steel Institute two papers of decided scientific importance were presented. In one of these Prof. G. Cesàro, of Liège University, a distinguished Belgian man of science, has endeavoured by careful mathematical analysis to ascertain the course of the curve joining the points at which molten iron-carbon alloys commence to solidify, if the abscissæ are taken either as x, the number of atoms of carbon contained in a unit of the alloy, composed of a hundred atoms, or as y, the number of molecules of cementite Fe_3C contained in a unit of the alloy composed of a hundred molecules, and assuming an iron molecule to contain two atoms. The author has used for his data the experimental results obtained by Carpenter and Keeling fifteen years ago, which are generally accepted as valid for the liquidus of the series. He comes to the conclusion that whether Raoult's law of the depression of the freezing point or the more general law expressed by the Le Chatelier-Schroeder formula

$$lz = \frac{Q}{2}\left(\frac{1}{T_0} - \frac{1}{T}\right),$$

where T is the absolute temperature and z is the number of molecules in the solvent contained in a unit of the alloy forming a single molecule, be adopted, the calculated figures agree decidedly better with the experimental results on the iron-cementite than the iron-carbon hypothesis. Further, the results which agree best are obtained on the assumption of a rectilinear variation afforded by the Fe_3C–Fe_2 hypothesis.

In the second paper Prof. Honda, of the Tohoku Imperial University, Sendai, Japan, returns to a consideration of the allotropic forms of iron. It is now generally agreed that pure iron undergoes two transformations between the freezing point and the ordinary temperature, which are allotropic. The first of these is the A_4 transformation, and takes place at 1394° C., about 130° below the freezing point. It is completed in a few minutes. The second is the A_3 transformation, and occurs at about 900° C. This transformation, although not so rapid as the previous one, can be completed in a very narrow temperature interval, provided the heating and cooling are sufficiently slow. In a recent experiment by Ishiwara, where the complete transformation required about three hours, the difference between the Ac_3 and Ar_3 points did not exceed 5° C.

The A_2 change is of a different nature. It does not take place at a definite temperature or within a small range, but begins at the ordinary temperature, its rate becoming greater as the temperature is increased, until it is completed at 785° C. The various physical properties, such as heat absorption or evolution, intensity of magnetisation, electrical resistance, thermal conductivity, etc., vary similarly with one another, the values changing slowly at lower temperatures, and the change becoming faster as the temperatures approach 785° C. When thermal equilibrium is established the change in any one of the properties does not increase by a prolonged heating. The properties are definite functions of the temperatures. It is this distinction, according to the author, which constitutes the essential difference between allotropic and non-allotropic changes. According to him, therefore, an allotropic change is the transformation of a substance from one phase to another which proceeds at a definite temperature if sufficient time be allowed for the transformation.

The A_2 critical point, as determined thermally, is usually taken as 768° C. This is the temperature at which the rate of heat evolution or absorption is at the maximum on cooling and heating respectively. This figure is somewhat lower than 785° C., which is the value proposed by Honda, and is the temperature at which the A_2 transformation begins on cooling and terminates on heating.

In the case of carbon steels, in addition to the above, there are two other transformations, A_1 and A_0. The former is a change of phase, while the latter is a change in cementite of a similar nature to A_2. Accordingly, whereas A_4, A_3, and A_1 are phase changes, the A_2 and A_0 transformations extend from the critical to the lowest temperature. Every stage of these changes is a definite function of the temperature, and, from the point of view of the molecular theory of magnetism, they may be regarded as processes in which the molecules acquire rotational energy about their magnetic axes.

H. C. H. CARPENTER.

SEX, REPRODUCTION, AND HEREDITY IN PIGEONS AND FOWLS.

DR. OSCAR RIDDLE has previously brought forward evidence to show that male pigeons arise from eggs (yolks) of less *storage* metabolism, which implies small size and higher (oxidising) metabolism, and that females arise from eggs (yolks) of greater *storage* metabolism, which implies large size and lower (oxidising) metabolism. He has now (*Journ. Exper. Zoology*, vol. xxvi., 1918, pp. 227–54) studied two cases of female "identical twins," and seeks to show that the ova (yolks) which produced both of them were extraordinarily and abnormally large.

Of course, the yolk of an egg cannot be directly weighed on a balance and then put back to see what it will develop into; Dr. Riddle's evidence is necessarily indirect. The eggs when laid were very large compared with all the other eggs produced by the particular parents (totals of 116 and 134 eggs). Double-yolked eggs in doves are practically restricted in their production to hybrids from wider crosses, or to birds showing striking reproductive abnormalities, or to both of these, and would not be expected to appear in the series in which the two cases of "identical twins" were found.

It is suggested that the blastoderm-borders will be abnormally raised in extraordinarily large eggs, and abnormally lowered in extraordinarily small ones, and that this might lead, for physical reasons, to the establishment of two independent foci of development. If male "identical twins" were found developing from a very small egg, it would be an interesting corroboration of the author's theory. Meanwhile, he thinks that the available data point to the conclusion that each pair of female "identical twins" arose from a single ovum of high storage metabolism.

In healthy doves and pigeons the right testis is larger than the left in a very high percentage of cases, yet in the female it is the left ovary that persists. The left testis more nearly approaches the ovary than does the right. In disease, particularly in tuberculosis, the testes undergo extreme atrophy, but more in the right than in the left; the ovary does not seem to suffer reduction in size. The right testis of the very young birds (from embryos to squabs a few weeks old) is normally longer than the left. The single (persistent) left ovary of young female squabs is twice, or more than twice, as long as is either testis in males of similar age (three to seven weeks). Now Dr. Riddle finds (*Anat. Record*, vol. xiv., 1918, pp. 283–334) that in hybrids the normal size relations of the two testes are often disturbed, sometimes reversed, approximating to the female condition. The number

of such reversed cases increases as the width of the cross. The excess of males from such crosses is also known to increase similarly, *e.g.* when the crosses are between members of different genera. The theory suggested is that "sex has been controlled in these forms, and that a male which is forced to arise from a female-producing egg may show in the relative size of its gonads an approximation to the relative size of the gonads of a female."

In an investigation (*Journ. Biol. Chem.*, vol. xxxiv., 1918, pp. 161–70) of the correlation between fat content in the blood of fowls and the total egg records, Dr. Riddle and Mr. J. Arthur Harris find a progressive change; it is positive for birds in a laying condition, sinks to zero after the cessation of laying, and finally takes a high negative value in birds which have long ceased to lay. At the end of the first laying year birds which have laid larger numbers of eggs and are still laying have a higher percentage of fat in their blood than laying birds which have made a poor record for the year. But birds which have laid a large number of eggs and exhausted their fertility have a smaller percentage of fat in their blood than non-laying birds which have poor egg records. Thus the correlation changes from a positive to a negative relationship. This conclusion involves a serious criticism of that reached by Warner and Edmond (*Journ. Biol. Chem.*, vol. xxxi., 1917, p. 281).

Dr. Riddle and Mr. Carl E. Anderson (*Amer. Journ. Physiol.*, vol. xlvii., 1918, pp. 92–102) gave ring-doves small doses of quinine sulphate, and found a marked reduction in the yolk size and total size of the eggs. It is well known that quinine reduces the destruction of nitrogenous components of the tissues, and probably checks the secretory activity of the oviduct, the product (albumen) of which is entirely of a protein nature. Furthermore, the presence of quinine in the yolk of the eggs probably checks the characteristic transformation of the nitrogenous compounds; the eggs are poor in yolk for some weeks after the dosage is discontinued.

From an egg produced by a pigeon under the weakening influence of "reproductive overwork" there was hatched in 1914 a female bird which might be called an ataxic mutation. Dr. Riddle describes the bird (Proc. Soc. Exper. Biol. and Med., vol. xv., 1917, pp. 56–58), which showed when young a marked lack of power over the voluntary movements of the head and body. The affected female was bred to two different males, and the derangement was seen through four generations descended from either. Of 175 young ones reared to the age at which the disorder might be exhibited, 119 were classed as normal and 46 as affected. With some irregularities the character appears like a Mendelian recessive

In an interesting study of the brains of the "ataxic" pigeons (*Amer. Journ. Physiology*, vol. xlvii., 1918, pp. 124–36), Miss Mathilda L. Koch and Dr. Riddle report that, as compared with normal birds of the same parentage, there are increased values for moisture, protein, and extracted sulphur, and decreased values for lipoids, phosphatides, and cholesterol. The results of the analyses are interpreted as suggesting a chemical under-differentiation or immaturity of the disordered brains.

Dr. Riddle and Mr. Victor K. La Mer report (*Amer. Journ. Physiol.*, vol. xlvii., 1918, pp. 103–23) a remarkable fact which must be considered in connection with theories of colour-inheritance, namely, the post-mortem formation of melanin in the pigmentless retinas and choroids of embryo white ring-doves of 3–12 days of development. Killing the tissues in $HgCl_2$ does not prevent the production of the pigment, but the presence of free oxygen is necessary.

INDUSTRIAL LIGHTING.

IN his lecture at the British Scientific Products Exhibition on July 28, Mr. L. Gaster traced the growth of interest in industrial lighting, which had now come to be regarded as essential to the health of the workers, to the avoidance of accidents, and to efficient work. The extension of night-work during the war and the great demands made on British factories had rendered good artificial lighting specially important; and various factors likely to operate in the future, such as the fuller use of the "three-shift" system and the development of the manufacture of accurately made standardised and interchangeable parts, also tended in the same direction. Another important consideration at present was the saving in fuel that might be brought about by the general use of more scientific and efficient methods of lighting, whereby the consumption of gas or electricity necessary to produce a given illumination on the work could be reduced. The case for adequate industrial lighting, both from the economic and humanitarian points of view, was very strong. There was no doubt that both the output and the quality of work suffered if the illumination was defective. Cases were on record in which the output had increased by 8–27 per cent., and even more, when the illumination was improved. In general, the cost of lighting formed only a small proportion (often less than 1 per cent.) of the wages bill, so that even a small gain in output more than compensated for the expenditure on good lighting.

Mr. Gaster also gave an instructive account of the steps taken by various Governments in Europe to promote better industrial lighting in the years immediately preceding the war. The French Government had nominated a Committee to inquire into the subject, and the Belgian Government had also been asked to do so. In these cases action had been inevitably delayed by the war, but the Departmental Committee on Lighting in Factories and Workshops, appointed by the British Government in 1913, had persevered with its labours, and issued a most instructive and valuable interim report in 1915. In this matter Great Britain might justly claim to have taken the lead in comparison with other nations. During the war, however, the United States, profiting by European experience, had been very active, and there were now five States which actually possessed codes of industrial lighting in force. Experience had shown that managers of factories were quite willing to adopt the recommendations in these codes, their chief desire being to receive assistance and guidance in bringing their illumination up to date. To the worker likewise good illumination was of direct personal benefit. Mr. Gaster expressed the hope that definite reference to adequate industrial illumination would be introduced into the British Factory Act in the near future. It was also desirable that industrial lighting should be included amongst the conditions of work to receive international treatment, so that there might be interchange of experience and uniformity of action in the chief countries of the world.

THE ROYAL SOCIETY OF CANADA.

THE sessions of the Royal Society of Canada were held as usual in Ottawa on May 19–22, and were of more than ordinary interest. There was an unusually large attendance of fellows from the various provinces, from British Columbia in the west to Nova Scotia in the east, and the presidential chair was occupied by the Hon. Rodolphe Lemieux, M.P., the distinguished French-Canadian statesman and jurist. Many fellows present had just returned from Europe,

their professional duties having ended with the conclusion of the war.

The Canadian Royal Society combines the features of the French Academy and the British Association, in accordance with the views of the founder, the late Duke of Argyll, who, as Marquess of Lorne, and occupying the office of Governor-General at the time (1882), originated the society. It includes French and English Literary and Historical Sections (Sections I. and II.) and three scientific sections, Chemistry and Physics (Section III.), Geology and Mineralogy (Section IV.), and the Biological Sciences (Section V.), and its fellows, about 150 in number, are able to assemble in session not more frequently than once a year, owing to the vast distances necessary to be travelled to reach the capital of the Dominion.

The serious duties of the meetings were relieved by many social functions, the principal one being the garden-party at Government House, given by their Excellencies the Duke and Duchess of Devonshire, on the afternoon of May 20. There was also a largely attended public luncheon, in honour of the society, on the following day.

As many as 131 communications were presented to the various sections, and of these 51 were chemical, physical, and mathematical, and 32 were botanical and zoological, but owing to the absence of the presidents of Sections I. and V. the usual opening addresses were omitted. In Section II. Principal Maurice Hutton, Toronto, gave a masterly disquisition entitled "Humour and Satire," with ancient and modern illustrations from Aristophanes to Jane Austen, Dickens, and H. G. Wells; and in Section III. Prof. L. V. King, Montreal, spoke on "Outstanding Problems of Modern Physics," and Prof. L. W. Bailey, University of New Brunswick, the Nestor of Canadian geology, addressed Section IV. on "Acadian Palæography." The president of the society (Mr. Lemieux) delivered an eloquent and remarkable address in French at the first evening session (on May 20) entitled "Le Canada, la Guerre et Demain." The second evening address took the form of a memorial lecture, viz. the "Sir John Murray Memorial Address," and the council invited one of the Dominion's most eminent biologists and the leading authority on the resources of Canada's seas, Prof. E. E. Prince, Commissioner of Fisheries, Ottawa, to deliver it. The annual popular evening address is always one of the attractive features of Royal Society week in the capital, and, as the generosity of an anonymous Scottish donor had provided for this special lecture, it proved to be a very notable event.

Prof. Prince appropriately chose as his subject "Life in the Ocean: A Review of Recent Deep-sea Researches," a subject which formed the late Sir John Murray's life-work. The spacious ballroom of the Château Laurier was packed by a crowded audience, and moving pictures of fish-life under the waves and of whales and whaling, and exquisite coloured projection views of marine vertebrate and invertebrate life, added greatly to the interest. Prof. Prince referred to the fact that Sir John Murray was a Canadian, born in Ontario in 1841, and at the time of his tragic death in Edinburgh was honorary vice-president of the Canadian Royal Society. He spoke of his own personal friendship, dating from student days at St. Andrews, when Sir John Murray occasionally visited the ancient university. After detailing the main features of the world's oceanic areas, their extent, profound depths, currents, salinities, etc., the lecturer emphasised the existence of unsuspected minute organic forms, enormous in amount, in the ocean's depths, and of organic detritus there, ultramicroscopic in its character. As the late Prof. Minchin declared, this invisible organic matter was of supreme moment in maintaining life in the sea. Dr. W. B. Carpenter fifty years ago had styled sea-water "minute broth."

The enormously abundant diatoms, infusorians, copepods, and the like could not suffice, it is generally admitted, for the nutrition of the incalculable hordes of mid-water and deep-sea creatures in the sea. A familiar sponge (Suberites), one ounce in weight, required 22 milligrams of carbon, to provide which nearly one and a half billions of such a diatom as Skeletonema, or more than seven billions of Thalassiosira, would be required to be ingested daily. A small copepod such as Calocalanus must capture and digest daily 9,750,000,000 Thalassiosira every twenty-four hours; and an oyster 5 in. long consumed, it has been calculated, one-twelfth of a cubic inch of solid food daily, and would need to filter eight or nine gallons of water, or nearly two thousand times its own bulk, to obtain that amount of nutriment. Dr. Kishinouye has stated that the Japanese sardine would require to wander nine miles through the sea to secure the $\frac{3}{4}$ gram of food constituting its daily diet; for 1 gram of diatoms, foraminifera, copepods, etc., usually occurs in 1000 litres of the water where the schools of fish feed.

Is there not some unsuspected source of abundant nutriment available in the sea? In addition to the plankton, with all its infinitely varied and copious life, Lohmann has signalised the nannoplankton, which passes through the finest tow-nets, and can be secured only by centrifuging small quantities of sea-water; but there remains the "Demerson," that extremely plenteous floating organic matter, invisible, disintegrating, probably largely moribund, derived from the sinking clouds of planktonic forms which "rain down," as Prof. Moseley expressed it, from the upper waters to the depths below. The "Demerson" finally settles on the floor of the sea as a thin colloidal stratum, as Bessels found in Arctic waters, and Hornell describes in Indian waters off the Malabar coast. Though the "Demerson" recalls the discredited Bathybius of Huxley, yet marine biologists are being compelled to recognise it as the great source of nutriment for innumerable Benthonic forms at all depths, from the coast to the abysmal zones in the oceans of the world.

At the close of the address President Lemieux, in thanking Prof. Prince for it, said that the science of the deep sea demonstrated how much stranger truth is even than fiction, and that Prof. Prince's long services in connection with the valuable biological stations of Canada, his wide experiences as a fishery expert in Canada, as well as in Irish, Scottish, New Zealand, and Australian waters, entitled him to speak with authority on fisheries and life in the sea generally.

At the closing business meeting of the society on the afternoon of May 22 the election of officers for 1919–20 took place, and it was announced that Dr. R. F. Ruttan, the distinguished professor of chemistry in McGill University, Montreal, had been chosen as the new president of the Royal Society.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—His Majesty the King has been pleased to appoint Dr. George Gerald Henderson, F.R.S., to the Regius chair of chemistry in the University of Glasgow. Prof. Henderson has held the chair of chemistry in the Royal Technical College, Glasgow, which is affiliated to the University, since 1892. He was formerly lecturer and demonstrator in chemistry at the University and at the Queen Margaret College

for Women incorporated with it. He was a few years ago president of the Society of Chemical Industry, and is a vice-president of the Chemical Society. The Regius chair, resigned by the late Prof. John Ferguson in 1915, has since then remained vacant owing to the war.

The following appointments to new chairs have been made by the University Court:—*Gardiner Chair of Bacteriology:* Dr. C. H. Browning, director of the Bland-Sutton Institute of Pathology at the Middlesex Hospital, and professor of bacteriology in the University of London. *Gardiner Chair of Organic Chemistry:* Dr. T. S. Patterson, Waltonian lecturer, and lecturer in organic chemistry in the University of Glasgow. *Gardiner Chair of Physiological Chemistry:* Dr. E. P. Cathcart, professor of physiology, London Hospital Medical School. These three important new chairs owe their foundation to the munificent endowment of Mr. William Guthrie Gardiner and Mr. Frederick Crombie Gardiner, shipowners, Glasgow. The sum of 20,000*l.* was provided for each chair—60,000*l.* in all. The benefaction contributes greatly to the equipment of the University for dealing with important scientific studies. The subjects of the chairs are among those in which some of the most remarkable modern developments have taken place. It is provided that the professor of bacteriology shall apply himself to the promotion of instruction and research in relation to bacteriology as bearing on disease, and that the holders of the other chairs shall apply themselves to the promotion of instruction and research in their different subjects.

LONDON.—Sir William H. Beveridge has been appointed Director of the London School of Economics.

Mr. T. L. Wren has been appointed to the University readership in geometry tenable at University College. In the session 1913–14 Mr. Wren was assistant lecturer in mathematics at Bedford College, and was then for two years lecturer at St. John's College, Cambridge.

A scheme was approved for the establishment at University College of a school of librarianship from funds provided by the generosity of the Carnegie trustees. The school will be administered by a committee consisting of representatives of University College and of the Library Association. Dr. E. A. Baker has been appointed director.

Lloyd's Register of Shipping has presented 10,000*l.* to the fund which is being raised to establish a degree in commerce at the University. The trustees of Sir Ernest Cassel have promised 150,000*l.* if a similar sum is subscribed before October. It is estimated that a sum of 500,000*l.* will be required to make suitable provision for the subject in the University.

The title of emeritus professor has been conferred upon the following:—Prof. Sir George Thane, who has resigned the chair of anatomy at University College, which he has held since 1877 (with the title of University professor since 1907); Prof. F. M. Simpson, who has resigned the chair of architecture at University College, which he has held since 1903 (with the title of University professor since 1907); and Prof. A. K. Huntington, who has resigned the chair of metallurgy at King's College, which he has held since 1879 (with the title of University professor since 1912).

The Senate has resolved to institute a University chair of botany tenable at Bedford College.

The following doctorates have been conferred by the Senate:—*D.Sc. in Biochemistry:* Mr. S. S. Zilva, an internal student, of the Lister Institute of Preventive Medicine, for a thesis entitled "The Influence of Deficient Nutrition on the Production of Agglutinins, Complement and Amboceptor." *D.Sc. in Physiology:* Mr. E. W. H. Cruickshank, an internal student, of University College, for a thesis entitled (1) "The Production and Utilisation of Glycogen in Normal and Diabetic Animals," and (2) "The Digestion and Absorption of Protein and Fat in Normal and Depancreatised Animals." *D.Sc. (Economics):* Mr. E. W. Shanahan, an internal student, of the London School of Economics, for a thesis entitled "The Production and the Consumption of Animal Foodstuffs, with Special Reference to the British Empire." *D.Sc. in Botany:* Mr. James Small, an external student, for a thesis entitled "The Origin and Development of the Compositæ," together with subsidiary contributions.

LT.-COL. SIR THEODORE MORISON has been appointed Principal of Armstrong College, Newcastle-upon-Tyne, in succession to Sir Henry Hadow.

PROF. W. M. GARDNER, head of the chemistry and dyeing department of Bradford Technical College since 1895, and principal of the college since 1906, is retiring on account of ill-health.

THE trustees of the Beit Fellowships for Scientific Research, which were founded and endowed in 1913 by Mr. Otto Beit in order to promote the advancement of science by means of research, have recently elected Mr. Jonas Arthur Hey to a fellowship. Mr. Hey was educated at the Keighley Trade and Grammar School, 1907–14, and has been a student at the Imperial College of Science and Technology since, except for the period of his war service. He will carry out his research at the Imperial College.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 7.—M. Léon Guignard in the chair.—C. **Richet**, P. **Brodin**, and F. **Saint-Girons**: The immunising action of sodium chloride against anaphylactic injection. The second injection of plasma, which normally causes a violent anaphylactic shock, can be rendered also innocuous by dilution with nine times its volume of an isotonic (0·8 per cent.) solution of common salt. The sodium chloride cannot be replaced by glycose. The plasma injected was from the horse, and dogs were used in the experiments, but the authors regard the immunising action of the salt as general, and not limited to these special cases.—A. **Blondel**: Some properties of the bipolar diagram of synchronised alternators on a network at constant potential.—V. **Grignard** and Ed. **Urbain**: The preparation of phosgene by means of carbon tetrachloride and oleum or ordinary sulphuric acid. The best yield of phosgene in this reaction is obtained with oleum containing 45 per cent. of SO_3, and SO_3HCl is left as the residual product. If the presence of some HCl in the phosgene is without objection, ordinary sulphuric acid may with advantage be substituted for the oleum, using infusorial earth as catalyst.—M. Emanuele Paterno was elected a correspondant for the section of chemistry in succession to M. G. Charpy, elected member of the division of the applications of science to industry.—V. **Karpen**: The cause of the adherence of the concrete to the iron in armoured concrete constructions.—MM. **Auclair** and **Boyer-Guillon**: An accelerograph.—J. **Ubach**: Observations of the annular eclipse of December 3, 1918, made at Buenos Aires.—F. **Diénert** and F. **Wandenbulcke**: The action of sodium thiosulphate upon hypochlorites. When a potable water has been treated with hypochlorite, it is

necessary to know the exact amount of sodium thiosulphate to be added to destroy the free chlorine. The course of the reaction is variable, depending on the presence or absence of free carbon dioxide in the water, and a direct laboratory experiment must be made in each case.—M. **Lespieau**: Cryoscopy in acetylene tetrabromide. This substance, when pure, melts at +0·13° C., and has a high cryoscopic constant, 217.—M. **Picon**: The preparation of some true substituted acetylenes by means of the monosodium derivative of acetylene. A description of the preparation of heptine, decine, and octodecine.—Ch. **Mauguin** and L. J. **Simon**: The action of concentrated sulphuric acid upon carbon tetrachloride.—S. **Posternak**: The constitution of the reserve phospho-organic principle of green plants.—A. **Krempf**: A primitive and essential stage, so far unrecognised, in the development of the Anthozoa.—A. **Rochon-Duvigneaud**: The double retinal fovea in birds of prey flying by day.

VICTORIA.

Royal Society, May 8.—Mr. J. A. Kershaw, president, in the chair.—R. H. **Walcott**: Origin of the volcanic tuff of Pejark Marsh, Victoria. The following results, giving further evidence of the formation *in situ* of the bedded volcanic tuffs, were obtained during excavations at this locality to find further data as to man's antiquity in Victoria. This evidence consists of the continuous thinning out of the beds away from the probable points of eruption, the cross-bedding present, and the gas cavities in the upper part not due to decomposition of vegetable remains; also in its being precisely like other tuffs which were undoubtedly formed in the same way both in physical and in mineralogical aspects.—F. **Chapman**: New or little-known Victorian fossils in the National Museum. Part xxiv.: A fossil tortoise in ironstone from Carapook, near Casterton. This is a replacement of the greater part of the body cavity of a tortoise, in which the vertebral column is well-marked. The sutures of the costal plates and the impression of the bones of the pelvic girdle are visible. The ventral surface shows the impress of the bones of the plastron. This cast is referred to Emydura, and with some reserve to the species *E. macquariae*, the Murray mud-tortoise. Pleistocene fossils of this species from Australia already exist in the British Museum (Natural History), London, as single bones. A curious point in physiography is suggested by the present occurrence: since the living Murray mud-tortoise is now found only in rivers flowing north into the Murray, the rivers of the Carapook district, which now flow into the Glenelg, probably had a northerly trend in the Pleistocene. This is also supported by local physiographic evidence.

BOOKS RECEIVED.

A Synoptical List of the Accipitres (Diurnal Birds of Prey). Part i.: Sarcorhamphus to Accipiter. Pp. 38. (London: John Wheldon and Co., 1919.) 4*s.*

A Student's Book on Soils and Manures. By Dr. E. J. Russell. Second edition, revised and enlarged. (Cambridge Farm Institute Series.) Pp. xii+240. (Cambridge: At the University Press, 1919.) 6*s.* 6*d.* net.

Union of South Africa: Province of the Cape of Good Hope. Marine Biological Report, No. iv., for the period ending June 30, 1918. Pp. v+182+ii. (Cape Town: Cape Times, Ltd., 1918.)

Planetary Rotation Periods and Group Ratios: Two Essays on the Relations between the Planets in Diurnal Rotation and in Mass. By F. A. Black. Pp. xii+115. (Edinburgh and London: Gall and Inglis, n.d.) 3*s.* 6*d.*

Shell Shock and its Lessons. By Prof. G. Elliot Smith and T. H. Pear. New impression. Pp. xv+135. (Manchester: At the University Press; London: Longmans, Green, and Co., 1919.) 1*s.* 6*d.* net.

Scientific Signalling and Safety. By Prof. John Joly. Pp. 36+1 plate. (London: Taylor and Francis, 1919.) 1*s.* 6*d.* net.

The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1919. Edited by Sir John Scott Keltie and Dr. M. Epstein. Fifty-sixth annual publication. Revised after official returns. Pp. lii+1476. (London: Macmillan and Co., Ltd., 1919.) 18*s.* net.

Volumetric Analysis for Students of Pharmaceutical and General Chemistry. By Charles H. Hampshire. Second edition. Pp. 127. (London: J. and A. Churchill, 1919.) 5*s.* net.

Lectures on Sex and Heredity delivered in Glasgow, 1917–18. By F. O. Bower, J. Graham Kerr, and W. E. Agar. Pp. vi+119. (London: Macmillan and Co., Ltd., 1919.) 5*s.* net.

Insect Artisans and their Work. By Edward Step. (Hutchinson's Nature Library.) Pp. x+318. (London: Hutchinson and Co., 1919.) 7*s.* 6*d.* net.

The Seashore: Its Inhabitants and How to Know Them. By Forster Robson. Pp. 111. (London: Holden and Hardingham, Ltd., n.d.) 1*s.* 6*d.* net.

Coal Mines and Nationalisation. By Dr. Arthur Shadwell. Reprinted from the *Times*. Pp. 32. (London: Longmans, Green, and Co., 1919.) 1*s.*

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THURSDAY, AUGUST 7, 1919.

THE FORESTRY BILL.

WE referred last week to the Forestry Bill, which has passed its third reading in the House of Lords and is now before the House of Commons. The Bill is a Government measure and is largely based upon the Report of the Forestry Sub-Committee appointed by the late Minister of Reconstruction. It creates a Forestry Authority consisting of five Commissioners, three of whom are to be paid, "charged with the general duty of promoting the interests of forestry, the development of afforestation, and the production and supply of timber in the United Kingdom." The Commissioners will have powers to expend 3,500,000*l.* during the next ten years in afforestation. This sum of money is to be at their absolute disposal, and will be subject to no control by Parliament or by any Minister responsible to Parliament. The powers conferred are thus very wide. The Commissioners may acquire land, compulsorily if necessary, and may plant trees themselves, or aid, by loan or grant, owners of land to plant. They may establish and carry on woodland industries. Education in forestry is to be promoted by the establishment of schools and by aid to existing institutions where forestry is taught. The Commissioners may also make inquiries and undertake experiments and research.

It will be obvious from this synopsis that the Commissioners will have the charge of a great national undertaking, which, if it were a business proposition, would need to provide evidence that the men who are to be entrusted with the work possess the qualifications necessary to give confidence in their successful accomplishment of it. In other words, if the Bill represented a company prospectus involving the control and expenditure of three and a half million pounds, little of this amount would be subscribed in the absence of any assurance as to the satisfactory constitution of the directorate. This, however, is exactly what the Bill neglects to supply. There is nothing to ensure that any of the Commissioners—paid or unpaid—shall have any knowledge of forestry; so that, just as we have had a Dyes Commissioner without special knowledge of the subject with which he was concerned, the Forestry Commissioners may similarly become purely political appointments.

We are glad that there is one body which watches national matters of this kind with the view of promoting efficiency and economy by the right use of scientific knowledge and experience. There is no group of men of science in the House of Commons apart from that of the medical members; therefore it must be left to those outside the House to make strong representation of their views when measures demand it. The British Science Guild has done this in the case of the Forestry Bill; and it is to be hoped that the action taken will ensure that the Forestry Authority will not be a purely amateur Board of Commissioners, but will include men who have had a sound scientific training and practical knowledge of forestry conditions—particularly those in the United Kingdom, with which the Commissioners will be concerned. Such men would secure adequate attention to forestry research and education, and would in addition be likely to see that the officers appointed upon the staff are well qualified to perform their duties. But even with a Forestry Authority which included Commissioners with expert knowledge, it would be a decided advantage if all officers were selected by an independent selection board.

In forestry, as in other departments of applied science, it is usual in this country to try to do without the expert, and to call for his advice only when compelled to do so by the failure of amateur administrators. The common attitude towards scientific and technical knowledge was expressed by Lord Ancaster in the House of Lords when he said recently:

"The Government, instead of making up the deficit in timber, seems to be chiefly engaged in questions of research. He did not claim to be a timber expert, but the thing was not so extraordinarily difficult as to require so many scientific gentlemen. There was no particular mystery about how to produce timber. To make the country self-supporting in the matter of timber, the great thing was not to set up commissions and lecturers, but to dig holes and plant the trees." (Laughter.)

The answer to this is that Lord Ancaster and his class have been planting trees on this simple plan for more than a hundred years, with the result that "the annual yield for the 3,000,000 acres under woods in the United Kingdom was only 45,000,000 cubic feet, or about one-third of what it should have been under correct sylvicultural treatment." (Reconstruction Report, p. 4.) So far as it deals with training and research, the Bill is, as Lord Haldane pointed out, Lilliputian. The amount supposed to be spent in research, which is really in a piteous condition in this country, is about 6000*l.* a year! No particular sum is, however, guaranteed by the Bill for this important work.

It is in connection with the planting of new ground, which will be one of the main duties of the Forestry Authority, that a well-planned and necessarily costly scheme of research and investigation is necessary. Lord Clinton, a member of the Interim Forest Authority, stated recently at Exeter that no farms would be taken to increase the woodland area. The new land to be acquired for planting must thus be restricted to lowland heaths and poor mountain pasture. The successful planting of such ground is a difficult problem if it is to be done at a reasonable cost. Research on new lines is imperative. The services of the best men in plant ecology, soil geology, botany, dendrology, etc., must be enlisted, and a proper team gathered together, in order to study the conditions which militate in this class of ground against tree growth, such as acidity of the soil, exposure to wind, etc. Arrangements must also be made for the selection of seed from the best sources.

Foresters in this country now rely on Pacific Coast conifers for the rapid production of timber in great quantity and of good quality. The Douglas fir and Sitka spruce are the main species employed, and so far these wonderful trees have been successful. *Thuya gigantea,* equally lauded and in many places already planted on a considerable scale, has suddenly been attacked by a fungus which threatens the extinction of this species. This untoward event may act as a warning against Lord Ancaster's view that it is only necessary to dig holes and plant trees. Much more knowledge is required of exotic species in regard to their adjustability to the new environment to which they are exposed in this country.

As to the replanting of the vast woodland areas felled during the war, the Forestry Bill appears to adopt the policy of the Report of the Forestry Sub-Committee of the Ministry of Reconstruction, which practically advocated the immediate purchase and planting of new land on a large scale, while it neglected to deal in a satisfactory manner with the question of replanting. The authors of the Forestry Bill, like the framers of the Report, apparently do not wish to antagonise the landowners by providing for compulsory replanting. This, it seems to us, is a needless fear on their part, as all wise landowners will replant. The argument in favour of compulsory replanting is simple. The Reconstruction Sub-Committee concedes the principle that afforestation is essential to national safety, and consequently should be carried out regardless of cost. It is not too much then to ask the landowners, who during the war sold their timber at an increased price, to replant the denuded areas. This they are morally bound to do on patriotic grounds. It is, moreover, the only way of utilising economically the denuded areas. A compulsory replanting clause should be introduced into the Bill. It will be a very easy measure to carry out, as it is analogous to compulsory tillage schemes, which have been very successful. To sum up, it is the business of the Forestry Authority to concentrate during the first five years on replanting, and to proceed cautiously with schemes for afforestation of poor land —the only kind that will be available.

We owe to Lord Lovat's strenuous advocacy the principle adopted in the Bill of a single Forest Authority for the United Kingdom, independent of all control, and subject to no interference from the existing Boards of Agriculture of England and Scotland and the Department of Agriculture for Ireland. Against this principle there is the Haldane policy that forestry should be developed in close association with agriculture both in administration and in the practical working out of schemes for buying suitable land for planting. The main point of view of Lord Lovat's policy as embodied in the Bill is to secure supplies of timber in the country in the interests of national safety, and no regard is to be paid to cost. Forests are a national necessity, and the country must have them, even though the money expended yields less than the current rate of interest on the capital involved. We are in favour of the Bill, which aims at an important national work that has been too long delayed, and for neglect of which in the past we suffered much in pocket during the war. It is devoutly to be hoped, however, that now the Bill is in Committee of the House of Commons the scientific and practical aspects to which we have directed attention will be improved for the sake of ensuring efficiency in this important national enterprise. Great praise should be given to the earnest efforts of Lord Lovat and his coadjutors in preparing the valuable Reconstruction Report, on the basis of which the measure is founded. That they have succeeded in inducing the Government to take up afforestation seriously is due to their energy, and augurs well for their success in carrying out afforestation in this country once the Bill becomes an Act.

HYDROGEN IN WAR AND INDUSTRY.

The Chemistry and Manufacture of Hydrogen. By Major P. Litherland Teed. Pp. vii + 152. (London: Edward Arnold, 1919.) Price 10*s.* 6*d.* net.

ONE of the most characteristic phases of modern industrial chemistry is to be seen in the extraordinary and unlooked-for development in the application to utilitarian purposes of the substances collectively known as the gases.

A few decades ago the majority of these bodies then known were regarded in the light of "chemical curiosities" rather than as potentially useful products. They were interesting to the student on account of their theoretical significance, but had little practical value. The present generation has seen all this changed. There is scarcely one of the commoner gases and few even of the rarer ones that have not been turned to a useful account. It is unnecessary to multiply instances of this fact. The examples of oxygen, nitrogen, chlorine, carbonic acid, nitrous oxide, ammonia, acetylene, ethylene, and methane are familiar enough to everybody. Others might be named. And the process goes on. When argon was discovered it seemed inconceivable, from the very nature of its inertness, that it could be of any practical use. But now argon is being extracted from the atmosphere on a manufacturing scale and applied in the electric lighting industry. Attempts are being made to utilise helium, and it is only the extremely limited supply which prevents the application of its extraordinary properties on the large scale. We may yet live to see the widespread use of niton as a therapeutic agent. In fact, he would be rash who would attempt to set any limit to the possible utilitarian application of a chemical product. History teems with examples which should warn us of the unwisdom of indulging in any such restriction.

Among the several gases which have of late years received an extraordinary development of application is hydrogen—the subject of Major Litherland Teed's little book. Although one of the earliest of the gases to have its individuality clearly recognised—namely, by Cavendish, who in 1766 made an approximately accurate estimation of its lightness—it received no application, except as an occasional chemical reagent, until it replaced the expanded air of Montgolfier's fire-balloon, and this remained its chief use until coal-gas became more generally available for aerostatic purposes. In war-time, however, hydrogen, for obvious reasons, was still employed for the inflation of balloons, and much of the development of the technology of hydrogen has resulted from war-time necessities. Many manufacturing processes, in fact, owe their origin entirely to the enormous demand for the hydrogen required to fill kite balloons and airships. The knowledge and experience thus gained are directly available for the ever-growing applications of hydrogen in the chemical arts, as, for example, in the synthesis of ammonia, and in the hardening of oils and fats by catalytic agencies, both of which processes have now become highly important chemical industries. What the future of synthetic ammonia will be remains to be seen. As yet its production has made comparatively little progress in this country, but the "coal question" is bound to affect its prospects, and to what extent, if any, synthetic ammonia will replace by-product ammonia is not wholly clear. On the other hand, the application of M. Sabatier's cardinal discovery of the effect of hydrogen, under the influence of metallic catalysts, in transforming oils and other unsaturated fats into edible products has solved a very pressing problem, which threatened at one time to become acute. It has been the means of adding enormously to the food supply of the world.

Major Teed's monograph consists of five comparatively short chapters. In the first two he gives a concise account of the physical and chemical properties of the gas, the mode of its discovery, the manner of its occurrence in Nature in the free or occluded state, and its reactions with other chemical elements and with certain compounds, particularly with animal and vegetable oils. There is necessarily little of novelty in these chapters; their material is, for the most part, the common property of the text-books. Certain of the physical constants of hydrogen, such as its thermal values, density, solubility in water, transpiration, refractivity, and the relationship between its pressure and volume, are referred to an appendix. These matters are, however, dealt with as briefly as possible; it was doubtless considered necessary to treat them as completing the descriptive history of the subject. The account is generally accurate, and bibliographical references are freely given. We would, however, remark that Sir William Crookes's name is wrongly spelled on p. 7; "Moisson" (p. 19) should be printed "Moissan"; "Neuman" and "Strientz" should be "Neumann" and "Streintz." Moreover, in the table, p. 15, giving the volume of hydrogen adsorbed by finely divided metals, it should be stated that the amounts are *maximum* values; the amounts actually adsorbed are frequently much less in many cases.

The most generally interesting and most valuable section of the work is concerned with the manufacture of hydrogen on the large scale. This is dealt with in the remaining chapters. The processes in use are to some extent affected by local conditions. This is especially true of hydrogen to be used for aviation in war. But when the gas is to be employed for manufacturing purposes, and cost, ease, purity, and uniformity of production are important considerations, war-time methods are not necessarily to be preferred, and as a matter of fact these are seldom or never employed in industry. Manufacturing methods are purely chemical, purely physical, or chemico-physical. The choice of a particular method must depend upon the amount of the gas required, the use to which it is to be put, facility of transport, etc. In certain circumstances it may be better to buy the hydrogen than to make it on the spot. In some established industries, as in the electrolytic production of chlorine and caustic soda, hydrogen is a by-product, and its collection involves little additional cost; hence it can be obtained relatively cheaply. In other cases it may be preferable to establish a plant for its production. This may be electrolytic, or it may depend upon the separation of hydrogen from "blue" water-gas by metallic iron, or by the

Badische Anilin catalytic process, or by the agency of cold and pressure, as in the Linde-Frank-Caro process. All these methods have been carefully worked out, and all are in actual use on the large scale. Major Teed gives a succinct account of them, and of certain other less important processes, with such theoretical explanations as seemed to him necessary. A chemical engineer with actual experience of the working of hydrogen plants will probably find little in the description with which he is not already familiar, but the student and the ordinary chemical manufacturer who are desirous of learning something concerning the mode of producing hydrogen on the large scale for manufacturing purposes will find the book of considerable service. It is simply and concisely written, and well illustrated. The bibliography is fairly full, and the references to patent literature are ample. It would, however, have added to the value of the book as a work of reference if an attempt had been made to give a short analysis of this literature.

ORGANIC READJUSTMENTS.

Man's Supreme Inheritance. Conscious Guidance and Control in Relation to Human Evolution in Civilisation. By F. M. Alexander. Second edition. With an introductory word by Prof. John Dewey. Pp. xxviii + 239. (London: Methuen and Co., Ltd., 1918.) Price 7*s*. 6*d*. net.

THIS book, strongly recommended by Prof. John Dewey, philosopher and educationist, will intrigue the reader. It gives the weary traveller a vista of a promised land, in which he may walk with light steps, and breathe freely, and enjoy physical perfection. The particular path into the promised land is not precisely revealed, but one of the sign-posts is "respiratory re-education," and the general idea is that of substituting for carelessly acquired habits and out-of-date instinctive promptings a regimen—or, rather, an art—of conscious control and scientific guidance. Man is hampered by maladjustments to the complex artificial environment which he has evolved around him; return to Nature and to the simple life is impossible and undesirable; to rely on mystical breezes and emotional gusts to give the ship a prosperous voyage is to invite disappointment; what is needed is more intelligent seamanship.

Human evolution has been environmental as well as organismal, and the changes that are enregistered in the social heritage (city life, for instance) imply much that is unnatural for creatures who are zoologically open-air mammals, much to which the human body is far from being well adapted. To lessen the discomfort and hindrances implied in this imperfect adjustment all sorts of palliatives are tried; the author has faith in none. He believes only in a serious discipline, in conscious control. It is in vain to fall back on deeply rooted subconscious or instinctive promptings, for these were wrought out in relation to a very different order of things, and instead of being dependable guides they may be at times positively misleading. Habits of the body, such as ways of walking and breathing, which once served passably well, have to be superseded by something better, and Mr. Alexander's experience has led him to a large faith in man's educability. Well-thought-out discipline in conscious guidance and control will lead to the development of a new subconsciousness—cultivated, not inherited. The discipline indicated "will enable the individual to stand, sit, walk, breathe, digest, and, in fact, live with the least possible expenditure of vital energy. This will ensure the highest standard of resistance to disease." It is claimed that it will do more (and we can well believe it), that it will develop a new sense of bodily freedom and relief from strain, and that it will react on the inner life of thought, feeling, and will.

This is not the place for any discussion of what Mr. Alexander half reveals of his methods of neuro-muscular training in general, and "respiratory re-education" in particular; we must be content with directing attention to what is a very interesting contribution to the old question of "nature" and "nurture." The central idea is that man's supreme inheritance—to wit, a capacity for rational control—should be more deliberately utilised in the education of the body, in saving us from handicapping habits which artificial conditions all too readily induce, and in leading us to the realisation of powers which, in default of appropriate nurture, are all too likely to remain latent or half-developed. We forgive the author his very frequent repetitions and his frank self-advertisement, for we think that he has something very valuable to say. "We must break the chains which have so long held man to that directive mental plane which belongs to the early stages of his evolution. The adoption of conscious guidance and control (man's supreme inheritance) must follow, and the outcome will be a race of men and women who will outstrip their ancestors in every known sphere, and enter new spheres as yet undreamt of by the great majority of the civilised peoples of our time." This is a large order, but if we begin, Mr. Alexander assures us, we shall soon have abundant payment to account.

OUR BOOKSHELF.

A Geography of America. By T. Alford Smith. (Macmillan's Practical Modern Geographies.) Pp. x + 329. (London: Macmillan and Co., Ltd., 1919.) Price 4*s*. 6*d*.

THE writing of a short text-book is as much an art as the writing of a short story, and little latitude for self-expression can be allowed to those who work for schools. Mr. T. Alford Smith explains this limitation when he appends selected examination questions to his conscientious treatise. The details on which geography is founded still remain more important in the eyes

of examiners than the scientific outlook. In these circumstances our author goes forward very straightly. If he has to omit the tragedy of Hudson's ending, he inspires us by a good map of Amundsen's North-West passage, which is far less known, because it belongs to recent history. He cannot trifle with examiners by betraying emotion at the "revolutions of the globe," but he gives a good geographic account of the Ice age in America (illustrated by a map of the moraine-front and by an entirely inappropriate one of medial and lateral moraines in Switzerland), and he moves us effectively by his excellent choice of illustrations. The South American section opens an unfamiliar field before the reader. The dangerous dunes on the Mollendo-Arequipa line, and the fascinating glimpse of the Patagonian ranges, may be cited from these interesting pages. The unique nitrate-deposits of Chile (p. 258) might have received fuller mention, since the material is exported, not "for the preparation of various chemicals," but for the increase of the food supply of the nations, and its local refining and foreign distribution are among the romances of geography. G. A. J. C.

Carburettors, Vaporisers, and Distributing Valves used in Internal Combustion Engines. By Edward Butler. Second edition, revised and enlarged. Pp. viii+288. (London: Charles Griffin and Co., Ltd., 1919.) Price 12s. 6d. net.

IN the hundred or so pages of this work devoted to carburettors the author has scarcely done justice to the modern outlook, although he gives an interesting description of various types. The omission of the double Venturi form is remarkable. No mention is made of aero work, yet it was aviation which opened our eyes to efficiency.

Carburettor design is at last emerging out of the embryo stage, and the rule-of-thumb method of the inventor is giving place to scientific measurement. Instead of a list of carburettor patents, as given in the book, we should prefer some experimental figures establishing the order of merit of the different types and the justification of the claims of the inventors. Thus, if a simple carburettor of the Zenith or Claudel type does all that is claimed for it, why go to the trouble of fitting all sorts of extra air-valves? It would be interesting to know why complicated designs can persist side by side with simple ones.

The remaining pages of the work are devoted to vaporisers and injectors (suitable for stationary engines under fairly constant load), and to the consideration of types of valve gear. In this connection we think that the advantages of the sleeve valve gear are overrated.

Treating of valve gear, we should have expected some reference to the importance of turbulence of the charge for high-speed work. Also the design of induction pipes for multi-cylinder engines, and the vibration of air in such systems (affecting distribution and carburettor characteristics) are matters of importance and deserve some comment. W. J. S.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Wild Birds and Distasteful Insect Larvæ.

IN NATURE of July 24 is a letter from Dr. Walter E. Collinge entitled "Wild Birds and Distasteful Insect Larvæ." This letter starts with a statement with regard to the distasteful qualities of the larva and imago of the currant moth (*Abraxas grossulariata*, Steph.), an insect which, of all others, has probably been studied most in this connection. So long ago as 1889 Prof. E. B. Poulton, in his classic work on "The Colours of Animals," states (p. 169):—"All observers agree that birds, lizards, frogs, and spiders either refuse this species altogether, or exhibit signs of the most intense disgust after tasting it."

Experiments of more recent date have done nothing to refute this observation, and, what is more, the larva of this moth differs widely from other Geometrid or "Looper" caterpillars in making itself conspicuous by means of a gregarious habit and of the position which is assumed when at rest, in contradistinction to protective resemblance to twigs of trees, to the eaten edges of leaves, etc., exhibited by most other members of the family.

Further, from his observations upon the case of song-thrushes feeding their young upon the caterpillars of this moth, and from the fact that the latter, after their destruction by the birds had ceased, were found to be parasitised, Dr. Collinge raises a question of the possibility of the parasitised larvæ alone being rejected by birds.

It is true that parasitic insects, when depositing their eggs in the interior of caterpillars, sometimes cause an exudation of blood which dries over the wound and produces a mark which acts as a warning to other parasites not to oviposit in the same larva, but, in the case of a spotted insect like the present one, it is neither probable that such a mark would be noticed by a bird, nor is it likely that all the caterpillars experimented with by entomologists were similarly parasitised, even though insects which enjoy protection through conspicuity of warning colours are naturally subject to great persecution by their parasitic enemies.

A simpler and more logical explanation is applicable to Dr. Collinge's observations. In the first place, no insect, however well protected, is completely immune from attack by enemies, and in times of stress birds have long been known to subsist upon insects with highly distasteful qualities. Of the eight birds mentioned by Dr. Collinge as containing currant-moth larvæ in their gizzards, the great tit, the house-sparrow, and the cuckoo are known to eat bees from hives in winter or in spring, when food is very scarce. The blue tit, flycatcher, and chaffinch are also addicted occasionally to this habit of eating an insect with a powerful sting.

A habit, probably of local origin, is exhibited by the chaffinch when large numbers of humble-bees, and even wasps, are attracted to the fragrant blossom of the weeping white lime-tree (*Tilia petiolata*) in August. These insects are provided both with weapons of defence in the stings of workers and queens, and with warning colours in the shape of yellow and red bands interspersed with black, but all these protections break down when they have sipped the nectar from the flowers.

Queens, workers, and males alike are caught by the chaffinch, which usually, with a peck from its beak, first destroys the tail, dropping the latter to the ground, eats out the contents of the abdomen, then breaks into the thorax, and finally drops the hollow remains of the insect to the ground.

In 1912 young birds of a late brood accompanied their parents to two trees in Hertfordshire, but showed fear of the bees, and would eat them only when caught and offered by their parents.

The blue tit is said to treat hive-bees in much the same manner (Cheshire, "Bees and Bee-keeping," vol. ii., pp. 578–79, 1886).

The shrike, or "butcher-bird," pierces queen humble-bees through the side of the thorax, after catching them on the wing in its beak, apparently with the view of causing general paralysis before impalation upon the thorn during formation of the "larder."

Toads are known to feed voraciously upon hive-bees, swallowing them whole, and it is at present very doubtful if any of the birds mentioned are affected by the stings of bees; but the method of avoidance of being stung cannot be completely overlooked in the cases described for birds.

The cuckoo is especially addicted to feeding upon caterpillars provided with irritant hairs, and with this we have a rough series showing the downfall of distasteful qualities or defensive weapons in face of selective adaptation in enemies, which for generations must have been kept at bay by such protection in their would-be victims.

The currant-moth larva, then, has merely been eaten by the thrush, and possibly by the other birds mentioned by Dr. Collinge (save for the cuckoo, which is now adapted to eating distastful insects), when the stress of having to feed a family has made such a practice a necessity. In the case of the song-thrush and its young, the stress has disappeared after a period of seven days with the arrival on the scene of more palatable food.

The presence of parasites in the caterpillars left after this period can scarcely be more than a coincidence, and there is no proof that the caterpillars which the thrushes ate were not also parasitised. This explanation would seem more acceptable than Dr. Collinge's paradox based on the assumption that the larvæ of the currant moth are not unpalatable to the majority of birds in ordinary times.

EDWARD R. SPEYER.

New College, Oxford, July 29.

Luminous Worms.

THE paper by Dr. Gilchrist published in the Transactions of the Royal Society of South Africa, and referred to in NATURE of July 31, p. 433, should be of service in reviving interest in this country in the question: Do our indigenous Oligochæts display luminosity? So long ago as 1893 I directed attention to the subject in these columns (NATURE, vol. xlvii., p. 462), and in more recent years I have endeavoured to elicit information of a trustworthy nature on the question with but little success. The following worms which have been reported as exhibiting luminosity are common in this country:—Brandling (*Allolobophora* (*Eisenia*) *foetida*), *Enchytraeus albidus*, and *Henlea nasuta*. *Microscolex phosphoreus* or an ally is an importation Another worm, which is large, common, and easily observed, is Octolasium. It has a steel-blue body, clay-coloured girdle, and yellow tail filled with fat cells which are often attended by gregarines. Various questions await solution. Of what service, for instance, can luminosity be to creatures which have no eyes? *Helodrilus oculatus* is the only Lumbricid found in England possessing organs of vision, and these are rudimentary. They have been reported by Eisen as occurring in Sparganophilus also, two species of which, as I recently showed, occur in this country. Is it possible that light can influence Annelids in some way, and so facilitate sexual processes? It was affirmed by Flaugergues in 1771 that luminosity disappears in certain cases after copulation, and if that observation is trustworthy it is most suggestive. Dr. Gilchrist, in his paper on luminosity referred to above, suggests that luminosity is a protective device so far as South African worms are concerned, and his argument is very plausible. I believe that the yellow extremities of Octolasium serve the purpose of dazzling underground foes by emitting light.

The reports made years ago to the British Association of luminous worms found in Liverpool and in the bogs of Ireland have never led to any satisfactory issue. As I am now writing my monograph of British Oligochæts for the Ray Society, it would greatly interest and help me to receive living specimens of worms which betray phosphorescent properties, or any well-authenticated facts relating to the subject which could be used for purposes of publication or investigation.

HILDERIC FRIEND.

"Cathay," Solihull, July 21.

Protective Coloration of Birds and Eggs.

WHILE collecting information on the use of colour-protection among birds, my attention has been directed to what appears to be a very interesting generalisation, viz. that among birds which nest on the moors, sea-shores, and similar open places, (1) those which have the habit of remaining on their nests when danger threatens generally wear camouflaged uniforms, but their eggs seldom show any signs of colour-protection; while (2) those which are very shy and leave their eggs readily are generally conspicuously coloured, but their eggs are usually camouflaged.

Amongst the first class are capercailzie, nightjar, partridge, wild duck, and bittern; and amongst the shy ones with camouflaged eggs are lapwing, curlew, oyster-catcher, terns, ringed plover, and golden plover.

I do not remember to have seen this point mentioned explicitly in any book or paper, and should be greatly obliged to any reader of NATURE interested in birds who would give me any further information on the subject.

GEO. GRACE.

The Museum, Keighley.

Teeth of Sea-Otter.

IT is commonly stated that the sea-otter (*Latax lutris*) differs from other carnivora in having only two incisor teeth in the lower jaw. Through the kindness of an old Etonian, Mr. Ernest Edwards, our school museum has become possessed of a fine stuffed head of this animal. I was surprised, however, to note that this specimen has three incisors on both sides. In the books of reference to which I have access I can find no such case recorded, and I shall be grateful if any of your readers can give me information on the point.

M. D. HILL.

Eton College, Windsor, July 29.

The Late Sir Edward Stirling.

IN NATURE of April 3, p. 87, the late Sir Edward Stirling is referred to as director of the South Australian Museum. Sir Edward resigned from the directorate in 1913, and was succeeded by Mr. Edgar R.

Waite. On relinquishing control in the museum Sir Edward was appointed honorary curator in ethnology, which position he filled to the time of his death.

L. M. HARWOOD,
Acting General Secretary.
Public Library, Museum, and Art Gallery of South Australia, Adelaide, South Australia, June 4.

LABOUR AND THE HIGHER VALUES.

AFTER the weary and fruitless efforts of the past century by those engaged in enlarging the boundaries of truth to educate their masters to an appreciation of the national importance of such higher values, it is a relief to turn to their frank espousal by the representatives and spokesmen of Labour in this country and in America. To those for whom Labour stands for everything that is evil in the best of all possible worlds and who are content to absorb their judgments on contemporaneous problems with their breakfast, such a view will be bizarre. But scientific men who are accustomed to deal with facts, and form their conclusions therefrom, cannot fail to be interested in the very marked growth of appreciation in the humanitarian value of their work which has occurred in the ranks of organised Labour.

At its recent Atlantic City convention, as announced in last week's issue of NATURE, the American Federation of Labour resolved adequately and generously to support the activities of the Federal Government in pursuing, strengthening, and extending a broad programme of scientific and technical research as being of major importance to the national welfare. The resolution was based on five grounds: That the work forms the fundamental basis of all modern industry; that the increased productivity and well-being of the whole population ensuing therefrom are of far greater value than the cost of the work; that, after all possible methods of re-adjustment, there is a limit to the increase of the average standard of living in the community, which can be raised only by research and the utilisation of research in industry; that it is necessary for the solution of many of the most pressing problems immediately confronting the Governments; and, lastly, that the war has brought home to all the nations engaged in it the overwhelming importance of science and technology in war or peace.

In this country the Labour Party in its Report on Reconstruction last year, entitled "Labour and the New Social Order," insisted on greatly increased public provision being made for scientific investigation and original research in every branch of knowledge, and for the promotion of music, literature, and the fine arts, upon which any real development of civilisation depends. It is humiliating also to note that it should have been a deputation from the Education Committee of the Labour Party who found it necessary to point out to the President of the Board of Education the grave injury done to the cause of education by the exclusion from the older universities of men without money but with brains, and the welcome apparently accorded to men with money but without brains.

So far as the evidence goes, the causes of scientific education and scientific research at least seem to stand to profit enormously by the advent of a Labour Government. The view, of course, may be taken that this is the traditional lip-service to the higher values paid by all political aspirants for power alike, though the political expediency of expressing such sentiments in this country is not obvious. At least, if it be mere vote-hunting demagogy, it is of a startling and original kind!

Labour may be trusted to make one important contribution to government which has been too long lacking, in that it cannot fail to realise the fundamental importance of the productive and creative elements in the community. It is not likely to make the mistake of putting the cart before the horse, an amusing illustration of which is our habit of speaking of commerce and industry. One may expect that if it intends to foster scientific research its efforts, however mistaken, will not be open to the interpretation that the resources of the State will be used for the exploitation rather than the encouragement of the research worker.

Sums, by previous standards munificent, have recently been voted by Parliament for fostering scientific research. What scientific investigators have so far mainly got is a set of rules and conditions that some lawyer had drawn up presumably, by which any investigator who is so hard-up as to accept money from this source puts himself outside the law with regard to any commercial rights that may ensue from his work and vests them in the Government. Willing as scientific men may be that their brains should be exploited for the benefit of the community, it must be remembered that the community is a vague term comprising drones as well as workers. Those to whom the destinies of civilisation have been entrusted during the past century have not shown themselves either very generous or very intelligent in their appreciation of the higher values which make for national well-being and prosperity. Under them, slums and millionaires have been the chief output of creative science, which certainly could not be in worse hands under Labour. The intense appreciation of the higher values that is growing up among the leaders of Labour is perhaps the most hopeful sign of the times, and the education of the workers into the real aims, uses, and aspirations of science now, more than ever, calls for the co-operation and support of scientific men. F. SODDY.

AUSTRALIAN RAINFALL.[1]

IN the continent of Australia rainfall is by far the most important meteorological element to the agriculturist, there being large tracts of country where the annual precipitation is barely

[1] "The Australian Environment (especially as Controlled by Rainfall)." By Dr. Griffith Taylor. Pp. 188+plates. (Melbourne, 1918.)

sufficient to allow of profitable use of the soil for farming or raising stock. For this reason Dr. Griffith Taylor, who is becoming well known for his work on Australian meteorology, has recently produced a volume devoted entirely to the rainfall of the continent and its control over vegetation. The subject is dealt with in a very thorough manner, and it would be hard to overestimate the value of such a work in the case of a young agricultural country looking to great developments in the near future. To obtain a just appreciation of the meteorological conditions which govern the weather of the continent it is necessary to remember that the southern tropical high-pressure belt crosses the southern part of the country, while the equatorial low-pressure area lies off the northern coast. These systems fluctuate north and south with the sun, causing a very marked annual period in the rainfall. Thus the northern districts receive most of their rainfall in the southern summer, when cyclones from the northern low-pressure area strike the coast. On the other hand, the southern districts at this time of year lie under anticyclonic conditions and receive little rain, but in the winter, when the high-pressure belt has moved northward, the westerly winds of the southern oceans reach this region and the rainy season occurs. This movement to the north and south of the pressure systems and associated phenomena is well illustrated by an ingenious "Solar Control Model" which forms the frontispiece of the present volume.

To the casual student who is acquainted with the desert regions which cover a large part of Western Australia and has been in the habit of regarding the whole district as one of great aridity it may come as a surprise to learn that over a small coastal area running southwards from Perth the annual rainfall amounts to more than 30 in., a quantity which is equalled only in narrow belts along the south-eastern, eastern, and northern coasts. Furthermore, a map which Dr. Taylor has prepared shows that the "rain reliability" from year to year reaches a very high level in this tract of Western Australia, so that the lot of the farmer should be a happy one, at least so far as rainfall is concerned. The most variable and untrustworthy rains are found in the arid centre of the continent, where the annual fall amounts to about 6 in. only, and fluctuates widely from year to year. The chart of "rain reliability" forms a valuable feature of the book, as in regions where the fall is barely sufficient for farming it may make all the difference whether an almost constant fall can be expected from year to year, or whether periods of exceptional rain are likely to be followed by spells of drought through which no farming can be carried on. In a previous publication the author has made use of the "climograph," or temperature-humidity curve, for indicating graphically the suitability of a climate for man. As regards suitability for plant life rainfall is a more important element than humidity, and the "hythergraph" is here introduced to indicate changes of temperature and rainfall throughout the year. Hythergraphs are reproduced for typical extra-Australian wheat-, rice-, and cotton-growing lands, and by comparison with Australian curves indicate the possibilities of the different parts of the country for these crops. Tea and coffee growing is also considered in the same way.

For a detailed discussion the country is divided into fifteen districts, for each of which the conditions are considered very fully. An attempt is made to ascertain the type of pressure distribution which causes rain in the different regions, and each fall in the course of the lustrum 1910–14 is ascribed to one or other of certain pressure types. It may be questioned whether the cause of rainfall suggested on p. 58, the chilling of an air mass by contact with a colder body of air, is really productive of appreciable rain. In most cases of this kind an easier explanation seems to be found in the convection effects which are likely to be set up. The work is very fully illustrated, but one misses a good map of Australia whereon the different towns and districts mentioned could be located without the trouble of turning up an atlas. It is impossible to read a work of this kind without regretting that meteorologists have devoted so little attention in the past to measurements of evaporation. There can be few districts of the world for which any adequate evaporation data are available, and yet in a country like Australia the loss of water by this means must be second only in importance to the supply by rainfall. A very large amount of trouble must have been involved in the preparation of such a comprehensive work as that under notice, and students of Australian meteorology, as well as those responsible for the development of the country, have reason to be grateful to Dr. Griffith Taylor for the result of his labours. J. S. D.

GUSTAV MAGNUS RETZIUS.

PROF. GUSTAV RETZIUS, who died at Stockholm on July 21, aged seventy-seven, did more to enrich anatomical literature than any other man of his time. By his death there comes to an end a line of anatomists that has made Sweden famous for a century and more. Retzius's grandfather was professor of natural history at Lund; his father, Anders Retzius, the intimate friend of Johannes Müller, held the chair of anatomy in the Caroline Medico-Chirurgical Institute, Stockholm, in which he was in due time followed by his son Gustav, who devoted his life to working out, by improved methods, lines of research commenced by his father. In 1842, the year in which Gustav was born, Anders Retzius recognised that the form of the human head was an important mark of race, and initiated the system of describing the shape of heads and skulls by the proportion which their breadth bears to their length. Like his father, Gustav Retzius was an anthropologist

as well as an anatomist; as a young man of twenty-two he collected, edited, and published his father's anthropological researches, and from 1864 until his death devoted much of his time to unravelling the history of the inhabitants of Scandinavia. In 1900 he published a magnificent atlas, giving exact reproductions of ancient Swedish skulls; in 1902 he and his colleague, Prof. Karl Fürst, brought out an exhaustive work on the anthropology of Sweden. He published several papers on the Lapps and on the Finns. In 1909 he was invited by the Royal Anthropological Institute of this country to give the Huxley lecture, which he devoted to "The So-called North European Race of Mankind." He recognised the merits of the race, but took, as we think, an unnecessarily gloomy view of its future.

Great as were Retzius's contributions to anthropology, his extensive researches in anatomy are even more important. His father's first publication, in 1822, was devoted to the anatomy of the Myxine; the son continued that work. In conjunction with his colleague, Prof. Axel Key, who held the chair of pathology, Retzius published in 1875–76 a monograph in two great and splendidly illustrated volumes, which is still the standard work in all that relates to the cerebro-spinal coverings and spaces. Perhaps the main interest of his life was his investigations of the intricate internal ear or labyrinth of vertebrate animals, an account of which he published in 1881–84. His monographs on the structure of the cortex of the brain, on the end-organs of nerves, and on the brains of human races and of anthropoid apes, and his more minute researches on the morphology of spermatozoa and of nuclear structure, will provide biologists for all time with a sure groundwork on which to base their speculations. He was content to gather the facts and leave to others the more pleasant task of interpreting their meaning. He had the fortune to marry a lady who not only was in the deepest sympathy with his life's work, but also made it financially possible for him to place his researches at the disposal of all the world in a form which has earned the envy as well as the gratitude of every anatomist.

A. KEITH.

NOTES.

THE meeting of the International Research Council, which was opened at Brussels on July 18 in the presence of the King of the Belgians, concluded its labours on July 28. Much successful work was accomplished. The statutes of the International Council were finally agreed to, and unions embracing the whole subject of astronomy and the various sections of geophysics were formed. In other branches of pure and applied science proposals for the formation of international associations were discussed and formulated. These will have to be submitted to the authorities concerned in the different countries before they can be formally adopted. A resolution inviting the co-operation of nations that had remained neutral during the war was adopted unanimously. Brussels was selected as the legal domicile of the International Research Council. Its triennial meetings will be held in that city, and gifts or legacies will be administered according to Belgian law. But the associations dealing with special subjects will probably follow the established custom of holding their conferences successively in different countries. The secretariat of the council will be at Burlington House, where the Royal Society has placed a room at the disposal of the general secretary.

SIR ARTHUR BOSCAWEN, Parliamentary Secretary to the Board of Agriculture, moved the second reading of the Forestry Bill on August 5 in the House of Commons. In the discussion reference was made to the large expenditure of between 40,000*l.* and 50,000*l.* which is to be spent in the setting up of the new staff and other outlay; the divorce of agriculture from forestry, with the consequent impossibility of dealing adequately with the small holdings policy; and the friction which may arise between the agricultural and forestry authorities. Sir Philip Magnus pointed out that the chief defect of the Bill lay in its silence on the necessity of having on the central authority a preponderance of fully qualified scientific experts. He warned the supporters of the Bill and the Government of the grave danger of proceeding with this new afforestation scheme without the guidance of scientific advice, the neglect of which in the past had so often resulted in Government schemes ending in disaster. This aspect of the Bill he proposed to insist upon in the Committee stage of the Bill. Mr. Barnes, in replying as a Minister to the criticisms made, said he thoroughly agreed with Sir Philip Magnus as to the need for scientific men among the Commissioners, and that the point would be sympathetically considered

A COMMITTEE has been formed, under the chairmanship of Lord Rothschild, to establish a memorial to the late Frederick Du Cane Godman, in acknowledgment of his lifelong devotion to the interests of natural history and in grateful testimony of the many valuable benefits conferred by him in promoting the study of natural science in this country. At a meeting of the committee held at the Natural History Museum in April last it was resolved that the memorial should take, primarily, the form of a bronze tablet with medallion portraits of Mr. Godman and of the late Mr. Osbert Salvin, Mr. Godman's lifelong friend and collaborator in all his scientific enterprises, and that this tablet, with a suitable inscription, should be offered to the Trustees of the British Museum, to be placed in the Natural History Museum at South Kensington. The committee hopes to be in a position to do something additional to perpetuate the memory of Mr. Godman by helping to establish a less local form of memorial. Dame Alice Godman and her two daughters have offered to found an exploration fund with the sum of 5000*l.*, the proceeds of which are to be devoted to making collections for the advancement of science and for the benefit of the Natural History Museum. The committee, therefore, proposes that any amount received by it over and above that required for the bronze tablet shall be added to the exploration fund. It is hoped that this may form a permanent basis for future donations and bequests for the same purpose. The committee confidently asks for funds to carry out this scheme. Contributions should be sent to Mr. C. E. Fagan, hon. treasurer, Godman Memorial Fund, Natural History Museum, Cromwell Road, London, S.W.7.

THE autumn meeting of the Institute of Metals, under the presidency of Prof. H. C. H. Carpenter, will be held in Sheffield on Wednesday and Thursday,

September 24 and 25. This is the first gathering of the institute since 1913, when a meeting was held in Ghent. Among the communications to be submitted to the Sheffield meeting are:—Prof. P. G. H. Boswell, Moulding Sands for Non-ferrous Foundry Work; Prof. C. H. Desch, Second Beilby Report on the Solidification of Metals from the Liquid State; Miss H. E. Fry and Dr. W. Rosenhain, Observations on a Typical Bearing Metal; Dr. W. H. Hatfield and Capt. G. L. Thirkell, Season Cracking of Brass; R. E. Leader, The Early History of Electro-silver Plating; E. A. Smith and H. Turner, The Properties of Standard or Sterling Silver, with Notes on its Manufacture; Dr. J. E. Stead, The Ternary Alloys of Tin-Antimony-Arsenic; Dr. F. C. Thompson, Graphite and Oxide Inclusions in Nickel Silver; and Dr. F. C. Thompson and F. Orme, Some Notes on the Constitution and Metallurgy of Britannia Metal. It is expected that some hundreds of engineers and metallurgists from all parts of the world will take part in the proceedings, which will include visits to several famous works.

THE seventh annual meeting of the Indian Science Congress will be held at Nagpur on January 13–18, 1920. The Chief Commissioner, Sir Benjamin Robertson, has consented to be patron of the meeting, whilst Sir P. C. Râу will be president. The following sectional presidents have been appointed:—*Agriculture:* D. Clouston. *Physics and Mathematics:* Dr. N. F. Moos. *Chemistry:* B. K. Singh. *Botany:* P. F. Fyson. *Zoology:* E. Vredenburg. *Geology:* P. Sampatiengar. *Medical Research:* Lt.-Col. J. W. Cornwall. The honorary local secretaries are Messrs. M. Owen and V. Bose. Further particulars can be obtained on application to the honorary general secretary, Dr. J. L. Simonsen, Forest Research Institute and College, Dehra Dun.

THE Baly medal of the Royal College of Physicians, awarded on the recommendation of the president and council every alternate year to the person who shall be deemed to have distinguished himself in the science of physiology, especially during the two years immediately preceding the award, has been awarded this year to Dr. Leonard Hill. The Harveian oration of the college will be delivered by Dr. Raymond Crawfurd on St. Luke's Day, October 18; the Bradshaw lecture on November 6 by Dr. A. P. Beddard; and the FitzPatrick lectures on November 11 and 13 by Dr. E. G. Browne.

A GOOD account of that interesting race, the Nayars of Malabar, was much needed, and it has now been provided by a native writer, Mr. K. M. Panikkar, in the Journal of the Royal Anthropological Institute (vol. xlviii., part 2). Among the more important points he describes the strength of their village organisation, the undivided family and descent in the female line, and the classificatory system of relationship. Cross-cousin marriage is the orthodox custom, and the result of the influence of the Nampudiri Brahmans on their social system has produced those complications which render the study of it at once fascinating and difficult. In agreement with other observers, he regards the Talikeltu marriage as the actual and religious form, the girl being allowed after its performance to choose her own suitor; she does not mourn at his death, and is not regarded as a widow; but when the man who actually tied the Tali or symbol of marriage round her neck dies, she undergoes certain formalities of mourning. The existence of actual polyandry is still a matter of debate, but no case of the kind is said to have occurred during the last fifty years.

STUDENTS of fossil botany should not overlook Dr. Walkom's studies on the Mesozoic floras of Queensland, which are appearing as publications of the Queensland Geological Survey (A. J. Cumming, Brisbane).

THE issue of separate papers from the New Zealand *Journal of Science and Technology* renders a number of observations available in a very handy form. Prospectors will be especially interested in Mr. P. G. Morgan's "Magnesite and Dolomite in Australia and New Zealand," which contains numerous analyses of material greatly in demand.

IN two detailed papers on ripple-marks in sedimentary rocks (*Amer. Journ. Sci.*, vol. xlvii., pp. 149 and 241, 1919), Mr. W. H. Bucher lays stress on the production of ripples at rhythmic intervals in road-surfaces under moving loads, and in other cases where a surface is affected by friction, and regards ripple-mark as due to "the tendency of two substances in moving past each other to form a surface of contact which offers a minimum of resistance by substituting a rhythm for uniform motion." A useful bibliography is appended, and a marked addition is made to previous studies of the subject.

A BULLETIN by Mr. E. S. Simpson (Geol. Survey Western Australia, No. 77, 1919) on the sources of industrial potash in Western Australia is opportune in its treatment of glauconite, and it is pointed out that mixture of a greensand with superphosphate renders "much, if not all, of the potash in glauconite water-soluble." The alunite occurring in veins of kaolinised rock at Kanowna is stated to be widely distributed over the belt of weathering, and contains some 9 per cent. of potash. In view, however, of its possible origin in other cases through sulphur-bearing waters, there seems no reason why it should be confined only to weathered masses of rock.

PROF. OMORI's sixth memoir on the eruptions and earthquakes of the Asama-yama occupies the whole of the last Bulletin (vol. vii., 1919, pp. 327–456) of the Imperial Earthquake Investigation Committee. The greatest eruptive activity of the volcano was manifested during the years 1911–13. The year 1914, with which the present memoir deals, apparently forms the closing stage of the series. Indeed, after the explosion of November 20, 1913, the volcano remained quiet for nearly two months, resuming activity simultaneously with the great outburst of the Sakura-jima in southern Japan in January, 1914. In this year there were twenty-nine prominent eruptions, the last of which occurred on December 16, but from this day until March of the present year the volcano has been free from explosions, though not entirely from earthquakes of volcanic origin. The conclusion of the period of activity has been marked in several ways. The lava-floor of the crater has sunk almost to the level which it maintained before the great upheaval of 1912. The explosions caused strong detonations, but, with two exceptions, the precipitation of ashes was extremely slight. As the explosive activity declined the average duration of the preliminary tremors of the non-eruptive earthquakes increased, showing that their foci were situated either at a greater depth below the crater or at a greater radial distance. At the same time a larger proportion of these earthquakes were sensible without instrumental aid. In the sound-areas of four of the explosions in 1914 the silent zone was developed, the outer sound-area being at about the usual distance from the volcano, but in two cases diverging from the usual south-westerly direction to the south-east and east-north-east.

The fourth report of the Advisory Committee, associated with the Meteorological Office, on Atmospheric Pollution, dealing with observations in the year 1917–18, is published as a supplement to the *Lancet* for June 14. The first report gave the results obtained for the year 1914–15, and appeared in the *Lancet* of February 26, 1916. Uniformity of system is maintained in publishing the results, which adds much to the value of the observations. The stages of pollution are grouped under the first four letters of the alphabet, A having the smallest, and D the greatest, deposit per square kilometre; this method of classification greatly simplifies comparison. A list of the observing stations in different parts of the British Isles is given, showing in each case the position of the deposit gauge and the nature of the exposure. The Malvern gauge is representative of uncontaminated country air, whilst the gauge at Newcastle-upon-Tyne gives the highest degree of contamination. The air was much contaminated during April, 1917, the total solids at Newcastle-upon-Tyne amounting to 44·28 metric tons per square kilometre, which is more than double the amount in any other month except August, 1917, when the amount was 28·50 metric tons per square kilometre. At Malvern the largest amount of total solids was 5·15 metric tons per square kilometre in May, 1917. The report says:—"While the deposit of soluble matter is not strictly proportionate to the rainfall, it is obvious that there is a general tendency to vary directly with the rainfall." The insoluble matter and the amount of rainfall bear no such relation. Details are given relative to the experimental work carried on in the investigations. The report includes some notes from the Director of Botany in British Guiana; they represent quite different conditions from those holding in the United Kingdom.

Meteorological tables and notes are given for Falmouth Observatory for the year 1918 in a report of the Royal Cornwall Polytechnic Society. Observations have been continued for the past forty-eight years, and the average values with which the records are compared are for forty-five years—a period which ensures a great degree of dependence. The mean atmospheric pressure for the year was 1016·4 millibars (30·016 in.), which is 1·3 mb. above the average. In February the barometer attained a maximum of 1047·2 mb. (30·923 in.), and there have only been four higher readings previously, all of which occurred in January. The minimum barometer reading during the year was 976·2 mb. (28·83 in.) in November. September had the lowest mean temperature on record for that month, the mean being 55·9°; the previous lowest mean was 56·4° in 1910. The rainfall and general weather fully account for the abnormally low temperature. The total rain measured for September was 211·9 mm. (8·34 in.), which is the greatest for the month since 1871, and it was 5·24 in. above the mean for the month, and 1·56 in. more than the previous highest total for September. The rainfall for July to December was nearly double that in the first half of the year. Bright sunshine was registered for 1752 hours, which gives a daily average of 4·8 hours. During two severe gales in January and November the wind in gusts attained the velocity of 70 and 78 m.p.h. in the respective gales. A tabular statement is given of the sea temperature near the centre of the harbour for all months, and interesting and valuable comparisons are made with the corresponding air temperatures.

A lecture entitled "How the Cotton Plant Provides us with Foodstuffs and other Commodities as well as with Clothing" was delivered at the British Scientific Products Exhibition by Mr. Ed. C. de Segundo on July 23. In the course of his remarks Mr. de Segundo said that, although it had been confidently asserted at a conference held in Atlanta (Georgia) in 1907 that the production of cotton in the United States would be increased in the measure required to keep pace with the home (American) and the world's demands, the United States production had declined on the whole since that year, while the proportion of the crop taken by American spinning mills had risen from about 40 per cent. in 1907 to nearly 60 per cent. in 1918. Further, the world's production had decreased each year for the last four years, whereas, according to Prof. Todd, the world required a *cumulative increase* in the cotton crop of about 800,000 to 1,000,000 bales per annum, and therefore the vital importance of the rapid extension of cotton cultivation within the Empire must be patent even to the least discerning mind. Mr. de Segundo also dealt with the industrial utilisation of the residual cotton fibres retained by cotton-seed considered as a factor in cotton economics, and with the remarkably rapid development of the cotton-seed oil and feeding-cake industry during the past fifty years. Attention was directed to the value of cotton-seed flour which is prepared from the decorticated cake produced under the American system of milling cotton-seed, and contains about five times as much protein and fat as wheat flour. It was stated that the United States Government had officially recommended cotton-seed flour as a diluent for wheat flour. Cotton-seed flour was of a bright yellow colour, and thus the admixture of even a small proportion with wheat flour gave bread baked from the mixture a yellow tinge. Mr. de Segundo stated that if cotton-seed flour could be successfully bleached it might become of great economic value, having regard to the fact that about 80 per cent. of our annual consumption of wheat had to be imported. A number of small rolls made from a mixture of cotton-seed flour and wheat flour were exhibited and distributed among the audience. At the close of the lecture one of Mr. de Segundo's cotton-seed defibrating machines was exhibited in action.

Circular 79 of the U.S. Bureau of Standards gives an account of the methods of testing and the characteristic behaviour of the various types of dry cells in use in America. It provides a summary of the information at present available on the subject, and with a view to the ultimate standardisation of the manufacture of such cells it gives specifications for the various types, their sizes, cardboard cases, zinc cans, carbons, cloth bags, mixtures, seal, terminals, tests, voltage, and short-circuit currents. Copies of the circular may be obtained from the Bureau.

The new monthly review *L'Aéronautique*, published by Messrs. Gauthier-Villars et Cie, of Paris, bids fair to become a journal of considerable interest to those interested in aviation. The first number (June) is divided into three sections, viz. general, technical, and historical, the last being a chronicle of current events. The general articles are very well written and excellently illustrated. They are intended to appeal to the average reader and are non-technical. The technical section is independently paged, apparently so that it may afterwards be separately bound for reference. The chief article in this section of the present number is concerned with the determination of the best conditions for obtaining the greatest distance of flight for a given machine—a problem of much importance. The treatment is, however, very elementary, and some doubtful assumptions are made which prevent the attainment of a complete general solution of the

problem. A short note on the equations of similarity as applied to aerial propellers is also unsatisfactory, and indicates a lack of appreciation of the true meaning of the principle of dynamic similarity. Thus, while the general articles are good, the technical section leaves something to be desired, and we hope that in future issues it will more nearly approach the standard of the rest of the production. The quality of paper and letterpress is excellent, but the price of 3.50 francs per copy seems rather high for a publication of this kind, however well produced.

IN a paper published recently in the Philosophical Transactions (vol. ccxviii., A, p. 395), Dr. A. E. H. Tutton gives a further instalment towards the completion of that colossal task to the accomplishment of which he has devoted himself through so many years, viz. the complete crystallographic and physical investigation of the sulphates and selenates of the series

$$R_2M\left(\begin{smallmatrix}S\\Se\end{smallmatrix}O_4\right)_2, 6H_2O.$$

In the investigation of the double ferrous selenates of the alkalis with which this paper deals, special difficulties were encountered owing to the unstable nature, first, of the solution of ferrous selenate and, secondly, of the crystals of potassium ferrous selenate which decompose and become opaque within a few hours of their formation. The first difficulty was overcome by the method of preparation of the ferrous selenate by the action of selenic acid upon ferrous sulphide, and the second by preparing and investigating the crystals of the potassium salt in the depth of winter. The results of the investigation are in complete accordance with those previously obtained in the case of other members of the series, and show the regular progression of crystallographic and optical properties with the increase in atomic number (or weight) of the alkalis, and also the almost perfect isostructure of the ammonium and rubidium salts.

PROF. G. H. BRYAN'S "Tables of Bordered Antilogarithms, Trigonometrical Logarithms to every Two Minutes, Natural Functions on Three Pages, Tables of Exact Squares," which occupy twenty pages of the May issue of the *Mathematical Gazette*, present certain novelties which will commend their use to calculators. The antilogarithms are given to five significant figures up to the antilogarithm of 0·61, thereafter to four figures. This increases the accuracy in the lower figures, whether used directly as an antilogarithmic table or inversely as a logarithmic table. The logarithms of the circular functions are given to every minute from 0° to 5° and from 85° to 90°, and to every two minutes from 5° to 85°. The saving of space by reading up the page for angles between 45° and 90°, although satisfactory for the practised calculator, is not regarded favourably by the school teacher. The table of squares is to five significant figures for numbers lower than 316, and to six significant figures for higher numbers. The chief advantage is that the complete square is given for every integral number up to 999. The square of a number of four digits is obtained by use of the formula $(N+x)^2=N^2+(2N+x)x$. This is a disadvantage in rapid work. For true accuracy Barlow's tables are all-essential; for limited accuracy to four figures (a very useful thing in laboratory work) the table in Chambers's "Four-figure Tables" would probably be found more serviceable. There is not the least doubt, however, that Prof. Bryan has provided us with a convenient compact set of logarithmic tables of greater accuracy than any similar set which has hitherto been devised. For many important kinds of practical work it is amply sufficient.

FROM an article in the *Engineer* of July 18 we extract the information that the Mitta Mitta Dam on the Murray River, the boundary between Victoria and New South Wales, Australia, will have a total length of 3601 ft., divided into three sections:—(*a*) An earthen dam of 2700 ft.; (*b*) a concrete spillway 740 ft. long, including turbine wells; and (*c*) outlet works, 161 ft. long. The object of the dam is to effect the storage of 1,000,000 acre-ft., or 272,250 million gallons, of water, so as to secure a regulated flow of 240,000 acre-ft. per month for irrigation during the dry season. For this purpose a height of 94 ft. from the bed of the river to full supply level will be required. The earthwork, with a core of concrete, is on the Victorian side of the river, the site-formation being alluvial, overlying beds of sand and gravel, below which there is a layer of decomposed granite of varying thickness. The bedrock of grey granite is reached at a depth of 34 ft. below surface-level, and the dam summit is 85 ft. above the same datum, the level of the crest being such as to give a margin of 12 ft. above full supply level. The spillway lies across the bed of the river, and will be constructed entirely in concrete. The cost of the scheme, including contingent works, with a series of locks and weirs from Echuca, in Victoria, to Blanchtown, in South Australia, is estimated at 4,500,000*l*., and is being met by the States of Victoria, New South Wales, and South Australia, and the Commonwealth.

THE Scientific Instrument, Glassware, and Potash Production Branch of the Board of Trade has been transferred from 117 Piccadilly to 7 Seamore Place, W.1.

A LONG list of second-hand microscopes, spectroscopes, telescopes, and other instruments and accessories has been issued by the firm of Mr. John Browning, 146 Strand, W.C.2. Copies can be obtained upon application.

WE are asked to announce that Messrs. C. F. Casella and Co., Ltd., have removed their factory from Walworth to Walthamstow, and opened offices and showrooms at 49 and 50 Parliament Street, S.W.1, to which address all correspondence for the firm should be sent.

The *University of Chicago Press* has in preparation for appearance in the University of Chicago Nature-Study Series "A Field and Laboratory Guide in Physical Nature-Study" and "A Source Book of Physical Nature-Study." A book of current interest is promised by *Messrs. J. M. Dent and Sons, Ltd.*, for the autumn, viz. one dealing with the British coal industry. It will be the work of Mr. G. Stone, the assistant secretary to the Coal Commission, who is treating the subject from the historical point of view and that of present-day needs. In the latest list of *Messrs. Longmans and Co.* we notice "The Natural History of South Africa," F. W. Fitzsimons, 4 vols., two of which are in the press, viz. vol. i., Mammals, including the Vervet Monkeys, Baboons, Galagos, Fruit Bats, Insectivorous Bats, Lions, Leopards, Serval Cats, Black-footed Cats, African Wild Cats, Caracals, and Hunting Leopards; vol. ii., Mammals, including Civets, Genets, Mungooses, Meerkats, Earth Wolves, Hyenas, Jackals, Foxes, Wild Dogs, Otters, Honey Ratels, Muishonds, and Sea Lions; "Mensuration for Marine and Mechanical Engineers (Second and First Class Board of Trade Examinations)," J. W. Angles; and a new and abridged edition of "Human Personality and its Survival of Bodily Death," the late F. W. H. Myers, with a portrait and biographical sketch of the author.

The new list of announcements of *Mr. John Murray* includes the following:—"Travels in Egypt and Mesopotamia in Search of Antiquities, 1886–1913," Dr. E. A. Wallis Budge, 2 vols., illustrated; "Conifers and their Characteristics," C. C. Rogers; three additions to the Imperial Institute Monographs on Mineral Resources, viz. "Manganese Ores," A. H. Curtis; "Tin Ores," G. M. Davies, and "Tungsten Ores," R. H. Rastall and W. H. Wilcockson; "Industrial Problems and Disputes," Lord Askwith; and new editions of "Hydrographical Surveying: A Description of the Means and Methods Employed in Constructing Marine Charts," the late Rear-Admiral Sir W. J. L. Wharton, revised and brought up to date by Admiral Sir Mostyn Field; "Microscopy: The Construction, Theory, and Use of the Microscope," E. J. Spitta; "Principles and Methods of Taxation," Dr. G. Armitage-Smith; and "Economic Statesmanship: The Great Industrial and Financial Problems Arising from the War," J. Ellis Barker.

OUR ASTRONOMICAL COLUMN.

THE AUGUST PERSEIDS.—Some of the earlier members of this rich annual shower were visible on July 30 and August 2, and, from the numbers seen, it is probable that the return this year will be an unusually abundant one. At Bristol on August 2, during a watch of the heavens extending over $2\frac{3}{4}$ hours, forty-one meteors were seen, of which eighteen belonged to the special display of Perseids. Their radiant point was at $38°+55°$, and it was not a sharply defined centre, but an area extending over about $7°$ in diameter. This marked diffusion is rather greater than what is usually observed, for the shower radiant is often rather small and definite. The maximum of the shower may be expected on August 11 and 12, but it is unfortunate that on these dates the moon will be nearly at the full, and will hide a considerable number of the smaller meteors. The Perseids, however, are a shower yielding a large proportion of brilliant meteors, so that even in strong moonlight the event is likely to present a conspicuous aspect.

KOPFF'S PERIODIC COMET.—The following search ephemeris for comet 1906 IV., period 6·6 years, which was not seen in 1913, is published by M. Ebell.

For Greenwich Midnight.

	R.A. h. m.	S. Decl. ° ′	Mag.
July 20	19 15·2	11 34·6	10·2
August 21 ...	19 17·9	9 3·8	10·7
September 22 ...	19 49·2	8 30·7	11·5
October 24 ...	20 38·4	7 23·9	12·3

An observation by Dr. Wolf on July 30 gives R.A. 11 minutes greater than, and declination $1° 14'$ N. of, the place shown by this ephemeris.

MIRA CETI.—Observations of this variable star about the time of its maximum in 1918, made by members of the Société Astronomique de France, are given in the Bulletin of that society for July. The dates estimated by the different observers at or between which the maximum may have occurred are as follows, the magnitude being added in brackets:—October 5 (3·3), September 23 (3·0), September 2–October 11 (about 3·9), September 21 (3·3), and September 25 (3·2); whilst another observer also records a double maximum on September 10 (3·65) and October 5 (3·85). Noting that the observer whose estimate is October 5 made no observation between September 11 and 26, it may be reasonably inferred that Mira Ceti was at maximum about September 23, 1918, when it was at least as bright as magnitude $3\frac{1}{4}$. According to similar observations made in the previous year, the maximum occurred about October 5, 1917. The length of the mean period generally adopted for the variation of this star is 331 days, which, applied to the date September 23, shows that maximum should happen this year about August 20. M. Flammarion's *Annuaire* names August 23 as the date. Mira has been comparatively faint at recent maxima, not having been brighter than third magnitude. It was practically of the second magnitude in 1906.

ROYAL OBSERVATORY, EDINBURGH.—Prof. Sampson's report for the year ending March 31 last has again to record a restriction of work owing to the absence of the two senior assistants on important Admiralty service. In these circumstances the attention of the Astronomer Royal for Scotland appears to have been given largely to the time service and to the study of improvement in clocks. A 24-in. mirror is being made by Mr. George Calver to take the place of one of the same size on an existing telescope, the figure of which is considered imperfect, and with the instrument thus improved it is proposed to determine stellar magnitudes by the photo-electric method, the process of which is being studied.

PATENTS IN RELATION TO INDUSTRY.

AN important conference on "Patents in Relation to Industry" was held, under the presidency of Lord Moulton, in connection with the British Scientific Products Exhibition, organised by the British Science Guild at the Central Hall, Westminster, on July 31, when some of the main features of the Patents and Designs Bill now before the House of Commons came under review. Sir Robert Hadfield, who opened the discussion, mentioned that those who had been trying to get changes introduced into the patent law were, at this juncture, being strongly supported by the Federation of British Industries and the British Commonwealth Union. These two important bodies intended, he said, to press for (*a*) an extension of the present term of fourteen years; (*b*) the introduction of the American file-wrapper system into this country; and (*c*) the appointment of a judge possessing special scientific knowledge as president of the court that had to deal with patent matters. Messrs. W. W. Reid, Hunter Gray, K.C., D. Leechman, and James Swinburne, and Sir G. Croydon Marks also took part in the discussion.

The remarks of the speakers made it evident that there exists a widespread feeling that the patent law of this country is inadequate for the present needs of industry, and, moreover, that it fails to afford the inventor suitable encouragement. Although the modifications of the law proposed in the 1919 Bill will, it is agreed, introduce desirable changes, a feeling appears to exist that in this Bill are repeated many of the weaknesses of the Bill withdrawn last year. Very general agreement exists on the point that renewal fees should be considerably reduced; such reduction, it was pointed out, can be effected at once without any fresh legislation, as the Treasury and the Board of Trade already possess the necessary powers to afford the inventor the relief required by him in this matter.

Lord Moulton, in bringing the discussion to a close, stated that, however excellent may be the case for obtaining a modification of the patent law, no progress will be made in the matter unless and until it is realised that the first thing essential to be done is for those who desire reforms to convince the Press and the people of the country that it is from the point of view of the public interest that questions affecting

patents are looked at and taken up. It is apparent to everyone, he said, that few inventions of the present day are really meritorious; he, therefore, regards the theory of renewal fees as a very excellent means for getting rid of patents that are not valuable. Such patents only put a restraint on invention, since improvements are choked so long as a master-patent remains in force. Lord Moulton expressed his approval of the American file-wrapper system. He pointed out that a patent specification must be drawn up in the utmost good faith in order that the public may have the full advantage of it when the patent in due course lapses; such is not always the case at present, since where the real inventor is a foreign resident abroad complete disclosure of the invention rarely takes place. The 1919 Bill will, in his opinion, constitute a new charter for the inventor. The public is determined, he said, that patents should help the trade of the country, and not strangle it as they have done during the past thirty or forty years.

THE LISTER INSTITUTE OF PREVENTIVE MEDICINE.

THE twenty-fifth annual report of the governing body of the Lister Institute recently issued gives a useful summary of the activities of the Institute during 1918.

Miss Muriel Robertson has continued her researches upon the anaerobic bacteria which infect wounds, with particular reference to the *vibrion septique*, the organism of malignant œdema. The reactions of this organism have been worked out, a toxin has been prepared from it, and with the toxin an antitoxic serum has been prepared and the serum issued to the Army.

Much work has been carried out for the War Office Committee for the Study of Tetanus, presided over by the chairman of the governing body of the institute, Sir David Bruce. Sir David Bruce has continued his analysis of tetanus cases occurring in home military hospitals. During 1918 292 cases of tetanus occurred among 380,000 wounded men, an incidence of 8 cases per 10,000 wounded. During the first three months of the war the incidence was 74 cases per 10,000 wounded. This drop has been chiefly due to the prophylactic use of anti-tetanic serum. The rate of mortality has similarly fallen—from 58 per cent. to 25 per cent.

Mr. Bacot, of the entomological department, has carried out numerous experimental tests of processes and methods aiming at ridding the troops of lice as a result of which a method for the destruction of lice by a moderate degree of dry heat has been devised and has been practically applied in the field on a large scale. Large numbers of lice have also been reared for use in other investigations concerned with the transmission of disease by these pests, particularly typhus fever and trench fever.

A number of researches concerned with food problems have also been carried out at the institute. Dr. Harden and Dr. Zilva, in conjunction with Dr. Still, have prepared a potent extract from lemon-juice for use in cases of infantile scurvy.

An investigation on the effects of cold storage on the fat-soluble accessory factor of butter is in progress.

An experimental investigation on scurvy, commenced in the autumn of 1916 by Dr. H. Chick, has already yielded valuable results. Thus it has been found that West Indian lime-juice is much inferior to lemon-juice in the prevention of scurvy. Yet in the British Navy and mercantile marine and in Arctic exploration last century lime-juice was vaunted as a preventive of scurvy. From an historical inquiry conducted by Mrs. Henderson Smith the important and interesting fact emerges that the "lime"-juice which was employed in these circumstances was actually made from lemons!

When during 1917 and 1918 there was a scarcity of oranges and lemons, experiments were instituted in order to ascertain if a cheap substitute existed containing the anti-scorbutic properties of these fruits, and swede-juice was ascertained to be most effective and not much inferior to orange-juice.

This brief summary surveys only a portion of the activities of the institute, but suffices to indicate the valuable work which has been carried out. The governing body proposes that the institute shall in the future be termed the Lister Institute for Medical Research, and suggests that a research hospital in connection with the institute would add greatly to its usefulness. Steps are being taken to give effect to these proposals.

COLLOIDS AND CHEMICAL INDUSTRY.[1]

ANYONE familiar, even in the least degree, with the general nature of chemical industry, and the applications of chemical science to other sciences, cannot but be impressed with the importance which colloid chemistry has attained within recent years in these two directions. In order that the significance of this branch of chemistry, hitherto very largely neglected, particularly in its scientific aspect, may be more fully appreciated and recognised, a committee of the British Association was formed in 1917 to consider the problem.

Last year (NATURE, March 28, 1918) attention was directed to the publication of the first report of this committee. The object which the committee has in view is to prepare in the form of sectional reports a summary of information respecting the present position of colloid chemistry and its various applications to other sciences, and especially to chemical industry. Each section is written by an authority on the subject treated. The first report dealt with the following technical subjects:—Tanning, dyeing, fermentation industries, rubber, starch, gums, albumin, gelatin, and gluten, cements, nitrocellulose explosives, and celluloid.

The committee has now issued its second report, which appears under the *aegis* of the Department of Scientific and Industrial Research. It may be obtained from H.M. Stationery Office or through any bookseller. The general arrangement adopted in the first report is adhered to in the present one. This consists of (1) classification according to the scientific colloid subject, and (2) classification according to the industrial process and general application of colloid science to other sciences. Under the first head the subjects treated are:—(i) Peptisation and precipitation (W. D. Bancroft); (ii) emulsions (E. Hatschek); (iii) the Liesegang phenomenon (E. Hatschek); and (iv) electrical endosmose (T. R. Briggs). Under the second head are:—(i) Technical applications of electrical endosmose (T. R. Briggs); (ii) colloid chemistry in the textile industries (W. Harrison); (iii) colloids in agriculture (E. J. Russell); (iv) sewage purification (E. Ardern); (v) dairy chemistry (W. Clayton); (vi) colloid chemistry in physiology (W. M. Bayliss); and (vii) administration of colloids in disease (A. B. Searle).

It is only right to point out that the compilation of these sections represents a gratuitous contribution on the part of the compilers for the general benefit of

[1] Second Report of the British Association Committee on Colloid Chemistry and its General and Industrial Applications (1918). (Published for the Department of Scientific and Industrial Research by H.M. Stationery Office, 1919.) Price 1s. 6d. net.

all who may be engaged in pure or applied science or in industrial operations in which colloids play a part.

It is obvious, from the mere enumeration of the subject-headings, that a very valuable amount of material has been collected which, it is hoped, will serve the purpose of emphasising the fundamental importance of colloid chemistry for operations and processes which, at first sight, might appear to be wholly distinct.

A number of sections remain to be dealt with, and it is hoped that these will be included in the third report which is now in preparation.

W. C. McC. LEWIS.

THE BRITISH PHARMACEUTICAL CONFERENCE.

THE papers communicated to the British Pharmaceutical Conference at the annual meeting on July 22–23 attained an exceptionally high standard of pharmaceutical and scientific importance. Summaries of a few papers are subjoined.

K. Samaan, in "An Experimental Study of Strophanthus, Kombé, Seeds," clears up a former point of controversy by showing that the fat extracted from properly dried seeds by petroleum ether is devoid of physiological activity. Comparisons of the determination of strophanthin, physiologically and by various quantitative methods, showed Barclay's, Fromme's (1910), and Lampart and Mueller's processes all to give satisfactory results. For the preparation of strophanthus tincture 65 per cent. of alcohol is recommended.

In a general account of "Recent Advances in Vaccine Therapy," H. E. Annett points out that one of the greatest factors militating against success in vaccine treatment is the difficulty of ensuring that sufficient antigen is introduced into the blood-stream to overcome the effects of the infecting agents. Attention is directed to the importance of David Thompson's method (*Lancet*, June 28, 1919) for removing the toxins from vaccines without damaging the "antigen," so that quantities of such vaccines, ten to one hundred times greater than were possible before, may with safety be employed. The significance of this is illustrated by Dr. Wynn's striking discovery that, by employing what previously would have been regarded as enormous doses of suitable vaccines, cases of acute pneumonia, acute influenza, and acute influenzal bronchiopneumonia can successfully be treated. The doses employed contained, for an adult, 30–50 millions of *B. influenzae* and 50–100 millions each of *Diplococcus pneumoniae* and Streptococcus. By prompt treatment on these lines an attack of influenza can definitely be aborted.

E. Berry contributed an important paper on "A Standardisation of Digitalis Preparations." The disadvantages of the physiological method of standardisation by determination of the minimum lethal dose are that a vivisection licence is necessary, and that a large number of frogs are required for each sample; further, the M.L.D. method records toxicity only. The author puts forward a colorimetric process which is a development of that proposed by Martindale. Alcohol, saponin, and digitoxin are first removed from the tincture to be tested, after which the residue is treated with Frohde's reagent, and the significance of the colour produced read off from a colour-chart. The result records the equivalent M.L.D. values for the *water-soluble* glucosides only, and is termed the "therapeutic value" of the tincture, (A). A second estimation carried out similarly, but in presence of 70 per cent. alcohol, and without removing digitoxin, etc., gives the M.L.D. equivalent of the *total glucosides*, (B). The "toxic value" is given by (B−A), and the comparative toxicity by the expression B−A/A. Comparison of these values with those afforded by a standard tincture gives a trustworthy evaluation of the preparation.

A. J. Jones, in "Purified Ether and the Variations of Commercial Samples," records the examination of nine samples prepared by different manufacturers. He directs attention to certain differences which exist between the "purified ether" of the British Pharmacopœia and "anæsthetic ether," and suggests that both types should receive official recognition, and a distinction drawn as to the special adaptations of the particular ether. This seems called for, as Dr. Cotton, of the McGill University, has recently put forward the view that absolutely pure ether is not anæsthetic in the full sense of the term; that it is narcotic, but not analgesic, the analgesic properties of ethers being due to traces of impurities—ethylene being suggested.

In a paper dealing with the couch-grass of commerce, "*Triticum repens*: A Commercial Rarity," Dr. James Small shows that the majority of a number of commercial samples examined consisted of *Cynoden dactylon*, or dog-grass, and not of the true couch-grass, *Triticum repens*.

T. E. Wallis, in "The Use of Lycopodium in Quantitative Microscopy," directs attention to the great value of this substance, which he shows to contain 94,000 spores per milligram, for determining the quantities of materials present in microscopic preparations.

In "Terebene and its Pharmacopœia Standards" B. F. Howard demonstrates the manufacturer's difficulty in producing a product which complies with the British Pharmacopœia requirement of optical inactivity and specific gravity, owing to the great alteration in recent years in the character of American turpentine. He suggests that main reliance should be placed in a distillation standard.

Miss L. K. Pearson describes "A Comparative Study of the Pungency of Synthetic Aromatic Ketones related to Zingerone." The substances considered are of the type

$$C_6H_5.CH=CH.COOR \text{ and } C_6H_5.CH_2.CH_2.COOR,$$

where one or more hydrogens of the benzene nucleus are substituted by hydroxyl or methoxyl groups, and where R represents a methyl, ethyl, or phenyl radicle. The following are among the generalisations made:—(*a*) The saturated ketones are less pungent than the corresponding unsaturated ones; (*b*) an increase in weight of the side chain materially increases the pungency of the compound; (*c*) the replacement of the hydrogen of the phenolic hydroxyl group by an acyl radicle has very little effect; and (*d*) the replacement of the *meta*hydrogen of the benzene nucleus in *p*-hydroxyphenyl ethyl ketone by a methoxy-group brings about a decided increase in pungency, as does also the replacement by methyl of the hydroxylic hydrogen in the *meta*hydroxy-group of 3:4-dihydroxystyryl methyl ketone. The most pungent of all substances examined was *o*-hydroxystyryl methyl ketone.

In "Notes on the Examination of Eosins and Erythrosins," T. T. Cocking, J. D. Kettle, and E. J. Chappel give a method of estimation, and show the inferiority of the best pre-war German samples to those now being produced in England.

S. B. Tallantyre directed attention to the general applicability of the formaldehyde process for estimating bismuth, by which the preparation, after a preliminary decomposition with hydrochloric acid, is reduced by formaldehyde and sodium hydroxide to metallic bismuth.

C. K. Hampshire and C. E. G. Hawker, in "A Note on Vitamines: A Suet Emulsion for Infant-feeding," describe the preparation of a substitute for cream, which proved to be palatable and well-tolerated by infants.

Other papers contributed were "A Note on Japanese Chiretta," by V. Cofman; "Note on Tinctures of Iodine," by F. Burrows and H. Droop Richmond; and "The Examination of Valerianates," by H. Droop Richmond and W. T. T. Ainsworth.

A MODEL OF THE VOLCANO KILAUEA, HAWAII.

MODELS of land-forms are not new, but the art of reproducing the features in a naturalistic way without exaggeration of the vertical scale has not been attempted until recent years. A. Heim, of Zurich, was a pioneer in this work about twenty years ago. Mr. George C. Curtis was a student of Heim. Before attempting the difficult task of making a naturalistic reproduction of Kilauea, Mr. Curtis had made many models of note. Among the most important of these are the models of the cities of Boston and Washington, and the models of Bora Bora and Funafuti, coral atolls of the Pacific.

In February, 1913, the present writer engaged Mr. Curtis to make a model of the volcano Kilauea, on the Island of Hawaii, for the Geological Museum at Harvard University. Mr. Curtis went to Hawaii in March, and spent three months at the volcano, making a supplementary survey and taking panoramic photographs and colour sketches of the ground. The staff of the Kilauea Observatory, Prof. T. A. Jaggar and Mr. H. O. Wood, aided Mr. Curtis in every way possible. After the actual work of modelling had been started at Boston, Mr. Curtis found it almost impossible to reproduce the frozen lavas of the great sink of the volcano with the photographs that he had. Mr. J. Fred Haworth, a merchant of Pittsburgh, had become a master in kite-photography. He was glad of the opportunity to go to Kilauea and take kite views of the volcano, and this he finally did at his own expense. Without these views from the air it is very doubtful whether Mr. Curtis could have perfected the work undertaken. With these kite views, however, the modelling of the frozen lavas became much simplified. In waiting for the kite views the work on the model was delayed. If these views had been available when the modelling was started, the work would have taken only a year and a half instead of forty months, as was actually the case. In the future the naturalistic modelling of land-forms will depend largely on kite or aeroplane views for its accurate and speedy accomplishment.

The model of Kilauea is circular in form, 14 ft. in diameter, and has an area of modelling representing about 13 sq. miles. The scale is 1 : 1500, or 1 in. = 125 ft. The sizes of the men on the edge of the Halemaumau crater, the buildings, trees, and automobiles on the roads, give a good idea of the scale. This model, like the other naturalistic models of Mr. Curtis, has no exaggeration of the vertical scale. For the first time in model-making a cycloramic background has been used. It gives the feeling of vastness that we should naturally have if looking from a balloon on the country below. As the observer looks downward on this model he is virtually half a mile high in the air. Those who are familiar with Kilauea assert that the reproduction is as faithful to the actual ground as it is possible to make it. Although it has been impossible to represent every tree on the ground, many thousands of trees have been made by hand and each one placed in the plaster. The details of the lavas are remarkably true to nature.

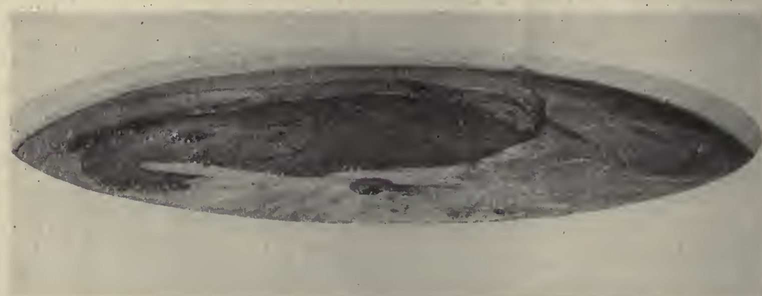

FIG. 1.—General View of the Model. The observer looks northward across the great lava sink. In the middle foreground are the extinct pit crater of Keanakakoi and the border of the Kau desert; to the right a small extinct pit crater. In the left middle distance is the active crater of Halemaumau (House of Eternal Fire). On the right of the main sink some down-faulted blocks may be seen. The Volcano House with its group of buildings is situated behind these. Note the dense forest on the left. On the right is the extinct crater of Kilauea Iki separated from the main sink by the down-faulted block of Byron's Ledge. On the left and on the cycloramic background rises Mauna Loa, 10,000 ft. above Kilauea and twenty-five miles away.

In addition to the many features of interest to the vulcanologist and the student of structural and dynamical geology, the model shows very well the effects of climatic control on the vegetation, due to trade winds and altitude. To the east and north-east of the Volcano House the forest is of a tropical nature in its luxuriance. To the west and south-west the vegetation disappears rapidly, so that on the western part of the model there appears nothing but a desert of volcanic ash. Three types of climate are shown: the top of Mauna Kea is frequently snow-covered; near the north and east coast and as far as the Volcano House is a tropical forest where the rainfall reaches the large amount of 300 in. a year; and west of the Volcano House is a desert where the rainfall may not reach 15 in. a year.

A model of this kind is expensive, and such models will never be cheap. With the use of kite or aeroplane photographs, however, the cost should be cut down by half. Museum staffs will ask the important question: Is the work worth while? Those who are qualified to answer this question have answered in the affirmative. The advantages of a good naturalistic

model are many. (1) Such a model of a volcano or of any land-form which changes during a generation of men is a scientific record of that locality, of great value to students of the present and future. (2) Such

FIG. 2.—In this figure the extinct pit crater of Kilauea Iki is seen. At the bottom is a sheet of frozen lava which shows black in the figure. The level of this lava is several hundreds of feet below the lava of the great pit. There has been a flow of lava from a point midway between the great pit and Kilauea Iki within historic times which flowed into Kilauea Iki. The sides of Kilauea Iki are very steep, but partly covered with vegetation. The road may be seen winding about the rim of the crater. With a reading-glass several automobiles may be seen, which give an idea of the scale of the model.

FIG. 3.—Photograph of the Kilauea model looking north-east across the pit of Halemaumau, the molten lake with its fiery fountains being just visible. The liquid lava is 350 ft. below the rim of the crater. The observation hut maintained by the Massachusetts Institute of Technology is on the left just back from the rim. Sometimes the molten lava rises nearly to the top of the pit, and again it will sink away so as to make the crater about a thousand feet deep. The dark grey lava field reaches to the base of the encircling caldera walls, in which the old bedded structures of ancient lava-flows, ash beds, and a laccolith may be observed. Taluses are seen in several localities at the base of the escarpment. In the left foreground is the summit point Uwekahuna, under which lies a stairway of great down-faulted blocks. Note the Volcano House group of buildings in the right distance, to the left of which are the brilliantly coloured Sulphur Bank and, behind, the dark forested slopes of the Kilauea cone.

models are of great value in research work. Several discoveries have been made by means of this Kilauea model. The volcanic bomb craters were practically unknown before the model was made. A young drainage system in the ash desert was also unknown previously. Prof. R. A. Daly has discovered that the land about Kilauea Iki slopes away from the crater in all directions, thus making of the Kilauea Iki area a dome similar to the area about Halemaumau. (3) The bird's-eye view of an area which can be studied at leisure reveals many relations between various features of the country which could not be well seen and studied in any other way. On account of the atmospheric conditions, no balloon or aeroplane observation or photograph could give at once such an ideal view as one obtains from the model. (4) The model can be used to teach students facts in geology, geography, and meteorology. The important things which a locality has to offer can be taught at home. (5) Such naturalistic models may be used in the teaching of landscape sketching and painting, and even in the teaching of map-making.

Although such models are worth while, the men who can make them are not easy to find. This is the real difficulty at present. Let us hope, however, that the revolution which kite or aeroplane views have made in this new art will encourage more men to undertake it. On account of the difficulty of obtaining orders for expensive models, Mr. Curtis has given up the work, and at present is farming at Willits, California. In order that the methods and technique which Heim and Curtis have gained after years of patient labour and study may not be lost, they should be described and published for the benefit of those who will continue from the point where these masters left off. ROBERT W. SAYLES.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. S. CHAPMAN has been appointed to the second chair of mathematics recently instituted in the University of Manchester.

DR. SAMUEL SMILES has been appointed to the newly created chair of organic chemistry at Armstrong College, Newcastle-upon-Tyne.

MR. J. W. THOMAS has been appointed lecturer in the electrical engineering department of the Birmingham Municipal Technical School.

MR. E. RAWSON, recently head of the Newcastle-upon-Tyne Training Centre, has been appointed head of the mechanical and civil engineering department of the Portsmouth Municipal College.

THE following appointments have been made at the London (Royal Free Hospital) School of Medicine for Women:—Mary Lucas Keene, lecturer in anatomy, and head of the anatomy department; John W. Ebden, Lawrence Abel, Mary Hounsfield, Mary Joll, demonstrators of anatomy; Bernard H. Spilsbury, lecturer in forensic medicine and toxicology; Eleanor Scarborough, demonstrator in pharmacology; M. Ross-Johnson and D. Woodman, demonstrators of physiology.

AN announcement has been received from the Technical Optics Department of the Imperial College of Science, South Kensington, that, subject to a sufficient response, Prof. Conrady will give a vacation course of sixteen lectures on "Optical Designing and Computing." For the convenience of students living at a distance two lectures will be given on each Tuesday and Thursday from August 26 to September 18 at 11 a.m. and 2.30 p.m. The syllabus includes methods of exact ray-tracing for axial and oblique pencils and approximate methods of treating aberration problems, together with the application of these methods to a number of typical optical instruments. Full lecture notes will be supplied to students a few days in advance of the lectures, leaving the greater part of the time free for a fuller discussion of the more practical aspect of the problems than would otherwise be possible. The fee for the complete course, including an optional computing course following the morning lectures, is 2*l.*, payable to the Registrar of the Imperial College. In the case of students who have taken certain previous courses the fee is reduced by one-half. It is particularly desired that names should be entered well in advance.

THE *Times* correspondent at Cape Town, in a message dated July 31, states that the Development Committee of the University of Cape Town is issuing a scheme of development which involves an expenditure of 525,000*l.*, of which 200,000*l.* is for buildings at Groote Schuur, 100,000*l.* for scholarships, 25,000*l.* for a library, and 200,000*l.* for general endowments. We learn from the same source that the Prince of Wales, as Chancellor of the University, has sent the following letter to the Vice-Chancellor:—"I wish, as Chancellor of the University of Cape Town, to assure you of my cordial support in the movement to improve the financial position of the University. The coming generation is called on to restore and rebuild the world. Failure in that task would imply that the sacrifice of those who fell in the war had been fruitless, and failure cannot be contemplated. Success depends on energy, goodwill, and, above all, on the spread of knowledge and of right thinking. The universities of the world can exercise a most potent influence on this great work of reconstruction, and it is because I feel convinced that a sacred duty to help in this work rests upon our University that I appeal confidently to its friends in South Africa and elsewhere to equip it, of their generosity, with the means worthily to do its part."

THE province of the engineer has in modern times become so amplified that the great majority of young men educated for that profession are, from the earliest days of their active professional career, now brought into immediate contact with the business side of engineering practice. For this reason a widening of the basis of the education provided at our universities for engineering students has been strongly advocated in recent times. To meet the needs of this situation it has been decided by the Senate of the University of Bristol to introduce commercial courses in the faculty of engineering. Syllabuses of these courses, which are now to be compulsory, have been prepared, and are available for distribution. The scheme outlined in the syllabuses comprises instruction in four groups of subjects, namely:—(*a*) Book-keeping and accountancy, (*b*) works administration and organisation, (*c*) commercial law, and (*d*) estimating and specification writing. Two courses are to be provided in each of the subjects (*a*) and (*c*), whilst subjects (*b*) and (*d*) are to be included in both the first- and second-year courses for engineering students. The main aim to be kept in view in courses of this kind should be to bring home clearly to engineering students the real importance of the business aspects of their profession, and at the same time to stimulate their interest in this side of engineering work. The syllabuses of the commercial courses to be introduced into

the engineering curriculum at the University of Bristol cover eminently suitable ground, and appear to be well designed successfully to achieve the purposes mentioned above.

ON Thursday, July 31, the King received at Buckingham Palace three deputations from public bodies, viz. the London County Council, the Body of English Presbyterian Ministers in London and the neighbourhood, and the General Body of Protestant Dissenting Ministers, who each presented an address of congratulation on the signing of peace after the terrible four years' struggle in which the nations of the world have been engaged, expressing the hope that we may now embark upon measures having for their object the continuous improvement of social conditions and the raising of higher ideals of life. In his replies to the several addresses the King expressed his strong conviction that nothing is more essential to national prosperity and happiness than education, and that the potentialities, physical, mental, and spiritual, of every member of the community should be developed to the fullest extent. If this were done, the life of the nation would be transformed within a generation. His Majesty alluded in terms of keen sympathy to the necessity for the care of the weak and helpless, for the protection of our infant life, and for the guardianship and training of the physically and mentally defective. New powers are being bestowed upon the public authorities, and the responsibility for their effective use rests with them. It is essential to raise the ideals of life throughout all classes. This implies due nurture and care of infant life, so that when the child comes of school-age it shall enter upon its formal education healthy in mind and body. To achieve this, better housing and more ample surroundings for light and air and healthy outdoor enjoyment are essential. If these conditions are established there will no longer be, as Sir George Newman recently reported, a million children out of six millions on the rolls of the elementary schools totally unfit, by reason of physical or mental defects, to make effective use of their educational opportunities. The King's sympathy and encouragement, so earnestly expressed to these deputations, ought to stimulate the zeal and the efforts of the local authorities to provide the facilities so necessary to the national well-being.

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, July 14.—Prof. A. W. Porter, vice-president, in the chair.—L. A. **Wild**: A method of measuring the magnetic hardness of ferrous metals and its utility for carrying out research work on thermal treatment. The coercive force forms a very convenient criterion for judging the physical condition of steel, as a small change in the heat-treatment conditions or composition of the steel results in the production of a much larger change in the coercive force. The method has been used for the investigation of many problems relating to the properties of steel.—F. H. **Jeffery**: The electrolysis of solutions of sodium nitrate, using a silver anode.—W. E. **Forsythe**: The disappearing-filament type of optical pyrometer. The paper discusses fully the principles that determine the accuracy and use of this type of pyrometer. The instrument is practically a telescope with a lamp filament at the focus of the objective, in series with a battery resistance and ammeter. The instrument is lighted in the hot body in such a manner that the image of the filament crosses that of the body. The current is then adjusted until the filament is just as bright as the body sighted. A red glass in the eye-piece eliminates difficulties due to colour differences.—E. A. **Ashcroft**: Some chemically reactive alloys. An alloy of 15 per cent. of pure magnesium with 85 per cent. of pure lead has the remarkable property that upon exposure to moist air oxidation of both the magnesium and the lead proceeds so rapidly that a lump of alloy so exposed swells up and falls to a black powder in a single night, or in some instances even in an hour or two. The experiment suggests a ready means of producing nitrogen or nitrogen and hydrogen mixtures from these alloys, or of removing remainders of oxygen from various mixtures in the cold.—Prof. H. **Honda** and H. **Takagi**: A theory of invar.—Prof. A. W. **Porter**: The equation for the chemical equilibrium of homogeneous mixtures. Part i.: Equilibrium at constant temperature. The general equation for chemical equilibrium is obtained in a way which is so much less abstract than the method depending upon the thermodynamic potential that no dubiety need exist of the meaning of the result and the conditions under which any particular form of it applies. The result is expressed in terms of the pressures of the constituents when isolated and in osmotic equilibrium with the mixture through membranes each permeable to one alone of the constituents.—Irving **Langmuir**: The mechanism of the surface phenomena of flotation. The paper directs attention to a theory of adsorption and surface tension which greatly aids in understanding the phenomena of flotation. The necessity for further researches is urged.

PARIS.

Academy of Sciences, July 15.—M. Léon Guignard in the chair.—G. **Bigourdan**: The pupils and temporary observers of the Observatoire de la Marine.—E. **Kogbetliantz**: The summation of ultra-spherical series. —J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the first quarter of 1919. Observations were possible on seventy-two days, and the results are given in tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—A. **Muguet**: A fluorometer. This instrument is based on the use of a number of superposed absorbent screens, and comparisons are made with a luminescent standard containing 1 mg. of elementary radium per square centimetre of surface, acting upon a barium platinocyanide screen.—H. **Abraham**, E. **Bloch**, and L. **Bloch**: Sensitive apparatus for the measurement of alternating currents.—F. **Taboury** and M. **Godchot**: A new method for the preparation of bicyclic ketones. Calcium hydride is used as the condensing agent, and it is noteworthy that the ketones resulting from the reaction are unsaturated, as the hydrogen from the calcium hydride is not taken up.—MM. **Vavon** and **Faillebin**: The hydrogenation of piperonal ketone and dipiperonal ketone.—E. **Léger**: Contribution to the study of cinchonidine.—G. **Chavanne** and L. J. **Simon**: The use of the critical solution temperature ("T.C.D.") in aniline for the rapid analysis of petrol. The method proposed gives the percentages of aromatic and naphthenic hydrocarbons.—A. **Duffour**: The hexahydrated potassium magnesium double chromate.—C. **Dauzère**: The formation of basaltic columns.—L. **Dunoyer** and G. **Reboul**: The prediction of barometric variations. A reply to M. Gabriel Guilbert.—Ch. **Maurain**: The velocity of the wind in the upper atmosphere in bright weather.—J. **Rouch**: The ascensional velocity of pilot balloons. From 168 measurements of velocity of pilot balloons it is concluded that the velocity of ascent is practically constant, and this holds for heights up to 10,000 metres For balloons weighing between 50 and

91 grams the velocity can be expressed by the formula $V=\frac{42F}{(F+P)^3}$, where V is velocity in metres per minute, P is the weight of the balloon, and F the initial ascensional force.—R. **Régnier**: The bacterial nodule of the poplar (*Micrococcus populi*). Observations on the development of the disease on the tree, and suggested means of preventing its spread.—P. **Carnot** and P. **Gérard**: Mechanism of the toxic action of urease. The injection of urease into the blood causes death by ammonia poisoning; the urea in the blood completely disappears and is replaced by ammonia.—R. **Fosse**: The formation of cyanic acid by the oxidation of organic substances. Its identification based on quantitative analysis. Aqueous solutions of glucose, glycerin, or glycocoll, oxidised by potassium permanganate in presence of ammonia, give cyanic acid as one of the oxidation products. This was identified by precipitating as the silver salt. The silver in this salt was determined by addition of ammonium chloride, and the urea formed from the ammonium cyanate separately estimated.—P. **Woog**: The variable persistence of luminous impressions on the various regions of the retina. Reply to an objection.—P. **Girard**: Relation between the electrical state of the cell-wall and its permeability to a given ion.—R. **de la Vaulx**: Intersexuality in *Daphne atkinsoni*.—J. **Pellegrin**: The Eleotris of the fresh-waters of Madagascar.—M. **Lienhart**: The possibility of chicken-breeders obtaining at pleasure male or female chickens. For a given strain of bird, the heavier eggs produce a higher proportion of males.—J. **Danysz**: The life of a micro-organism, individual and species.—P. **Delbet**: Researches on the toxicity of crushed muscles from the point of view of the pathogeny of shock.

CAPE TOWN.

Royal Society of South Africa, May 21.—Dr. J. D. F. Gilchrist, president, in the chair.—B. de St. J. v. d. **Riet**: Note on coloration produced in clay by injured roots of *Pinus pinea*. Instances were described in which vapours from injured roots of the stone pine produced, in warm sunshine, blue, green, and occasionally purple stains on soil and subsoil on occasions when excavations were made close to the tree. The author ascribed the phenomenon to (1) oxidation of volatile matter given off by roots of *Pinus pinea*; (2) the resulting oxidation products, or product, under favourable conditions reacting with iron salts in the clay (the well-known reaction between many phenolic carbon compounds and ferric salts); and (3) the production of a kind of lake with aluminium compounds in the clay.—Dr. J. D. F. **Gilchrist**: Note on the shells of *Schizoderma spengleri*. Shells of the bivalve Schizoderma are found in abundance on the Muizenberg sands, and present the peculiarity that they are either whole or broken up into small fragments. This seems to be due to the fact that, when the living animal is cast up on the beach, it is seized by the gull (*Larus dominicanus*) and dropped from a height of 20–30 ft. on the wet sand. This has the effect of causing both shells to open without injury, or one shell only is broken, rarely both. It was shown by experiment that this depends on how the shells fall.—Dr. **Dru-Drury**: An extreme case of microcephaly. The author describes the skull of a Basuto woman aged thirty-two which is preserved in the Port Alfred Mental Hospital. The type of skull is long-headed and narrow, with ape-like protrusion of the jaws (thick-lipped in life). The nose was of medium breadth and the orbits were unusually high. The cranial capacity is 340 c.c., which is much smaller than an average case of microcephaly.

BOOKS RECEIVED.

The British Freshwater Rhizopoda and Heliozoa. By J. Cash and G. H. Wailes, assisted by J. Hopkinson. Vol. iv.: Supplement to the Rhizopoda. By G. H. Wailes. Bibliography by John Hopkinson. Pp. xii+130+plates lviii.–lxiii. (London: The Ray Society, 1919.)

Camping Out for All. A Complete Handbook for All who Love the Out-of-Doors. By J. Gibson. Pp. x+81. (London: Gale and Polden, Ltd., 1919.) 2*s*. net.

Training for Young England. By F. G. Cooke. Pp. xiv+98. (London: Gale and Polden, Ltd., 1919.) 2*s*. net.

The Boys' Own Book of Great Inventions. By Floyd L. Darrow. Pp. ix+385. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) 12*s*. 6*d*. net.

Education for the Needs of Life: A Text-book in the Principles of Education. By Dr. I. E. Miller. Pp. vii+353. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) 7*s*. net.

The Sugar-Beet in America. By Prof. F. S. Harris. (The Rural Science Series.) Pp. xviii+342+xxxii. plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) 2.25 dollars.

British Science Guild: British Scientific Products Exhibition, Central Hall, Westminster, July 3 to August 5, 1919. Descriptive Catalogue. Edited by Sir Richard Gregory. Pp. xxiii+358. (London: British Science Guild, 1919.) 2*s*. 6*d*.

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THURSDAY, AUGUST 14, 1919.

PHOTOGRAPHY.

Photography: Its Principles and Applications. By Alfred Watkins. Second edition revised. Pp. xvi+333. (London: Constable and Co., Ltd., 1918.) Price 10s. 6d. net.

THE Watkins exposure meter is known wherever photography is practised, and the many other instruments that Mr. Watkins has introduced to render photography less haphazard than it so often is enjoy a wide appreciation. The author therefore comes to the task of writing a general treatise with what we may perhaps call a praiseworthy prejudice. Of this he is doubtless aware, for he says in his preface: "The greater attention given to my own methods in exposure and development will, I am sure, be forgiven." The author makes these methods clear and illustrates them well, and proves the error of certain notions that have been put forward from time to time, as, for example, that one should regulate the exposure of the plate according to the light that comes from the object rather than that which falls upon it.

As a practical guide for the ordinary photography of the amateur and the professional portrait photographer, the volume deserves commendation, although some important subjects are treated of with an unsatisfying conciseness. But when the author gets to matters of which he has presumably not made a special study, his statements are not so trustworthy. The confusion of "focus" and "focal length" has had such distinguished and prolonged patronage that perhaps we ought to pass it by; still, it is confusion, and it is avoidable. Mr. Warnerke is referred to as "Warneke," and Sir Joseph Wilson Swan, who died five years ago, as "Mr. J. W. Swan (now Sir John Swan)." With regard to Woodburytype, we are told that "a lead mould is made of a carbon print swollen in water so that the exposed parts are raised," and that "in the Woodburytype process the mould was taken by placing a polished sheet of lead on the wet carbon print and bringing both under heavy pressure in a hydraulic press." The gelatine relief was, of course, well dried before being caused to impress the lead. We have said enough to indicate that some parts of the book are much in need of revision.

The scope of the volume, as indicated by the table of contents, is very wide. We find stereoscopic work, panoramic photographs, enamels, ferrotypes, night photography, animated photography, "bioscope in colour," photo-telegraphy, photo-surveying by balloons, kites, and aeroplanes, telephotography, photomicrography, X-ray photography, astronomical photography, "spectrophotography," photo-mechanical processes, colour photography, etc., and each has at least an indication of its most obvious characteristics.

As the results of every method of sensitometry depend upon circumstances, and there can never be a standard method in a scientific sense, but only by agreement for the sake of convenience, all methods are of value, and we are glad to see that Mr. Watkins has again brought forward his "central speed" method. C. J.

A RECORD OF SCIENTIFIC PROGRESS.

British Science Guild: British Scientific Products Exhibition, Central Hall, Westminster, July 3 to August 5, 1919. Descriptive Catalogue. Edited by Sir Richard Gregory. Pp. xxiii+358. (London: British Science Guild, 1919.) Price 2s. 6d. net.

MERELY to enumerate the contents of this interesting volume would occupy more space than could be reasonably allotted to an ordinary review. But this catalogue is something more than a list of exhibits, even admitting that there is much instruction to be derived from the descriptions associated with the objects shown.

The catalogue contains, first, an introduction by Sir Richard Gregory, chairman of the organising committee, and, if read attentively, as it ought to be, especially by employers and manufacturers, cannot fail to have a stimulating effect. The list of exhibits shows that in many directions this country has regained control of important raw materials, and by the application of scientific knowledge and technical experience has achieved results of which, as Sir Richard says, "the nation has every reason to be proud. Now is the time to see that the strong position thus gained is not lost, and to unite the interests of the people of these islands with those of British lands beyond the seas."

The volume before us sets out the sources from which new experimental results have proceeded during the war, and in the first place shows the extent of the debt incurred to the scientific authorities of the universities and technical colleges throughout the kingdom. In despatches at the end of 1916 warm acknowledgment of the help thus given is expressed by Sir Douglas Haig, and in 1919, again, by General Sir Henry Wilson, Chief of the Imperial General Staff. But in the past manufacturers have been slow to make use of the results secured by research in the scientific laboratory, and it is, therefore, all the more satisfactory to find that during the last five years very many of them have recognised the necessity of using scientific knowledge and employing scientifically trained men in their works to a much greater extent than heretofore. The result is that many industries are now associated directly with research either in the separate factories or by a co-operative arrangement through the medium of research associations. To manufacturers, whether or not they are contemplating this question with a view to their own requirements, the facts and figures provided in the article on "The Organisation of Scientific Research in Works," by Mr. A. P. M. Fleming

(p. 77), will be found worthy of careful consideration.

To those who have been so long hoping that some day the importance of science in connection with industry would be recognised by the State, the Government scheme for industrial research is a source of satisfaction. The department now established has made a good beginning in affording assistance to many workers from the fund of one million granted by the Government and in encouraging the formation of research associations among manufacturers. Many of these are already in operation and are enumerated, with the names of their officers, in the comprehensive volume under notice.

THE BIRDS OF COLOMBIA.

Bulletin of the American Museum of Natural History. Vol. xxxvi., 1917. *The Distribution of Bird-Life in Colombia: A Contribution to a Biological Survey of South America.* By Dr. Frank M. Chapman. Pp. x+729+xli plates. (New York: The American Museum of Natural History, 1917.)

DR. CHAPMAN'S "Report on the Distribution of Bird-Life in Colombia" ranks amongst the most important contributions ever made to the knowledge of the ornis of the Neotropical Region, the avifauna of which stands unrivalled both in the wealth and variety of its feathered forms and in the number of its peculiar family and generic types. Colombia, thanks to Dr. Chapman's investigations, is now known to be the richest portion of this remarkable area so far as bird-life is concerned. That this should be so is due, no doubt, to the varied physiographical features to be found in that equatorial republic, for these range from tropical pasture-lands and forests at low, or comparatively low, levels to regions of perpetual snow in the Cordilleras, and include the uppermost tributaries of the Orinoco and some of those of the Amazon.

In the year 1910 the American Museum of Natural History organised and commenced a series of expeditions for the systematic exploration of the bird-life of the republic. These extended over five years, and were carried out under the direction of Dr. Chapman, who himself took part in them in 1910 and again in 1913. As the result of these systematic and well-organised explorations, 15,775 specimens, representing 1285 forms (species and subspecies), were obtained. Hence the report is based not only upon scientifically collected data, but also upon intimate personal knowledge of the country and its birds on the part of its author—a combination which has rendered the work of inestimable value.

As the result of his studies on this ideal system, Dr. Chapman recognises the following vertical life-zones: A tropical, which ranges up to 4500–6000 ft.; a sub-tropical, from 4500–6000 ft. to 9000–9500 ft.; a temperate, from 9000–9500 ft. to 11,000–13,000 ft.; a paramo (high plateau), from 11,000–13,000 ft. to the snow-line at 15,000 ft. These zones he again subdivides into faunal areas, so that the distribution of bird-life in Colombia is worked in remarkable detail. The author tells us that the uniformity of life increases with altitude, and that the distinctness of the various animals and plants of these several zones was a constant source of surprise and joy to him.

It is quite impossible here to enter into details of the various distributional problems unfolded by the author, but the portions of the work devoted to them are the most interesting and valuable to be found in this great work.

The systematic portion of the report treats in detail of the distribution, plumage, haunts, habits, etc., of the 1285 forms of bird-life which constitute the ornis of Colombia. Of these, twenty-two species and 115 subspecies are new to science. It is much to be regretted that Dr. Chapman has not included in his report the birds, some 400 in number, which had previously been recorded, but did not come under the notice of himself or his explorers. If this had been done it would have rendered his volume a complete record of all that is known to date of the avifauna of Colombia.

The volume is enriched by a series of reproductions of photographs of scenery depicting the various life-zones, and of useful maps and charts illustrating the distribution of species, forests, etc. It is further embellished by four coloured plates, devoted to the newly discovered birds, by the well-known zoological artist, Louis Agassiz Fuertes, who accompanied Dr. Chapman on two of his expeditions.

The author is to be heartily congratulated on the completion of his admirable work and on the masterly manner in which he has presented its results. Congratulations are also due to that enlightened institution, the American Museum of Natural History, which made this grand undertaking possible.

W. E. C.

OUR BOOKSHELF.

Practical Physiological Chemistry. A Book Designed for Use in Courses in Practical Physiological Chemistry in Schools of Medicine and of Science. By Prof. Philip B. Hawk. Sixth edition, revised and enlarged. Pp. xiv+661+vi plates. (London: J. and A. Churchill, 1919.) Price 21*s*. net.

THIS book, written by one of the best known of American physiological chemists, first appeared in 1907. Its success is evident from the fact that it is now in its sixth edition, and is due to the clearness and completeness of the practical instructions with which it is packed. It does not pretend to be a complete work of reference, but, though designed for the use of students, it is far too exhaustive for the ordinary student of medicine, who in the few years of his curriculum has to learn so many other subjects, and it is difficult to imagine that the American student can devote

more time to physiological chemistry, important as the subject is, than his brother in this country.

The book labours from the disadvantage under which all books which see many editions labour; no one is more acutely conscious of this than the present reviewer; it is so easy to add, so heart-breaking to excise. At the same time, Prof. Hawk has made a praiseworthy attempt to cut down the multiplicity of methods which assail him. For example, the only methods given for urea estimation are those based on the use of urease, and Van Slyke's procedure is the only one described for the determination of acetone bodies. The same ruthless use of the pruning-knife in relation to other materials (*e.g.* sugar) would add to the practical usefulness of a most admirable book.

It would be easy to criticise details; for example, the book starts with a study of the most difficult of all chemical problems, namely, enzymes, so that it is scarcely one to recommend to the beginner; then, too, it is not always up to date; for instance, we are told that English physiologists speak of metaproteins as infraproteins, a term they dropped many years ago; the account of muscle physiology does not appraise the work of Hopkins and Fletcher on lactic acid (probably the key to the whole situation) at its full value. But where so much is good, picking holes is neither profitable nor kind.

W. D. H.

Joseph Priestley. By D. H. Peacock. (Pioneers of Progress. Men of Science.) Pp. 63. (London: Society for Promoting Christian Knowledge; New York: The Macmillan Co., 1919.) Price 2*s.* net.

THE story of Priestley's life has been told and retold; but to the man of science it is always an attractive story, and to the general reader its appeal is perhaps scarcely less strong. To the chemist there is a never-failing interest in reading how this village minister, theological controversialist, and political reformer, who had no special scientific training and no particular facilities for experimentation, nevertheless was drawn to chemical studies, and acquired a just and lasting fame by his brilliant discoveries.

Priestley's mind was one of rare alertness, and if he missed many things through the weakness of his theoretical deductions, a remark of his biographer helps us to understand pretty clearly why this was so. "Chemistry was really little more than a hobby to him; theology was his life work. . . . Priestley was Priestley, not Cavendish."

Of this notable "pioneer" we get a good picture in Mr. Peacock's pages. There are only about sixty of these, but they suffice to tell pleasantly, even if briefly, of Priestley's early struggles, his prolific pugnacity in pamphleteering, his delight in experiments, his serenity under adversity, his pathetic exile, and his peaceful passing.

C. SIMMONDS.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Darwinian Statement of the Mendelian Theory.

So far as the present writer knows, no public notice has yet been given to a series of statements by Darwin in his "Animals and Plants under Domestication" that constitute virtually a statement of the Mendelian theory of the distribution and recombination of factors in hybrid offspring. Darwin's idea of dissociation is, of course, founded on Naudin's conception of disjunction, but the remainder of his theory is as original as Mendel's, except that it is purely speculative instead of being derived directly from experimental data. It is worked out, as a matter of fact, by means of his theory of pangenesis.

Darwin begins as follows:—"Another form of reversion is far commoner, indeed is almost universal with the offspring from a cross, namely, to the characters proper to either pure parent-form. As a general rule, crossed offspring in the first generation are nearly intermediate between their parents, but the grandchildren and succeeding generations continually revert, in a greater or lesser degree, to one or both of their progenitors" (vol. ii., p. 22).

He then quotes Naudin's view that "a hybrid is a living mosaic-work, in which the eye cannot distinguish the discordant elements, so completely are they intermingled. We can hardly doubt that, in a certain sense, this is true, as when we behold in a hybrid the elements of both species segregating themselves into segments in the same flower or fruit by a process of self-attraction or self-affinity, this segregation taking place either by seminal or bud-propagation" (p. 23).

Darwin goes on to comment on Naudin's view that the segregation of the male and female elements would be most likely to occur in the reproductive cells, since in this way their reunion through the fusion of pollen-grains and ovules would explain the phenomenon of reversion.

He then says:—

"If . . . *pollen which included the elements of one species happened to unite with ovules including the elements of the other species, the intermediate or hybrid state would still be retained, and there would be no reversion*" (p. 23).

Here is a statement of a theory of heterozygosis which, although not complete in exactly Mendelian form, is, so far as the writer knows, the first before the appearance of Mendel's paper. Darwin's more elaborate explanation comes later. He continues:—

"But it would, I suspect, be more correct to say that the elements of both parent-species exist in every hybrid in a double state, namely, blended together and completely separate" (p. 23).

Finally, in his chapter on pangenesis, Darwin approaches the theory of hybrids in thorough-going fashion, driving his pangenesis theory to its legitimate conclusions. By this theory, as is well known, it was assumed that the character-units existed in the somatic cells in the form of physical entities, however small, known as "gemmules." These, passing into the reproductive cells, conveyed thither the sum-total of the inheritance.

Darwin then approaches the subject of the theory of hybrids as follows:—

"The tendency to reversion is often induced by a change of conditions, and in the plainest manner by crossing. Crossed forms of the first generation are

generally nearly intermediate in character between their two parents; *but in the next generation the offspring commonly revert to one or both of their grandparents,* and occasionally to more remote ancestors" (vol. ii., p. 383).

The somatic cells of the hybrid, according to the theory of pangenesis, throw off gemmules carrying the character-units, and, as Darwin says, "by the same hypothesis dormant gemmules derived from both pure parent-forms are likewise present. . . ."

"Consequently," he continues, "the sexual elements of a hybrid will include both pure and hybridised gemmules; *and when two hybrids pair, the combination of pure gemmules derived from the one hybrid, with the pure gemmules of the same parts derived from the other, would necessarily lead to complete reversion of characters*" (*ibid.*).

Here we have as exact a presentation of the allelomorphic idea of homozygosis as could be wished. We have merely to substitute the word "factors" or "genes" for "gemmules" to have virtually a statement in the form of the Mendelian theory.

Finally, Darwin says:—

"And, lastly, hybridised gemmules derived from both parent hybrids would simply reproduce the original hybrid form" (*ibid.*).

Here is what appears to be, and substantially is on its face, a Mendelian form of explanation of recombination in heterozygosis, with this difference: According to Darwin's conception, the "gemmules," or as we should say "factors," come over, $Dr \times Dr$, from the respective parents in an already hybridised state, and give rise, simply by virtue of their all being there in a hybrid, to a complete bodily state of Dr—the hybrid condition—not, however, by means of segregation and recombination. Here is lacking, of course, the conception of separation and recombination according to the law of chance of D and r, giving $1\ DD : 2\ Dr : 1\ rr$. Such an explanation could scarcely have been expected to be worked out short of an experiment such as Mendel's, involving actual counts. It does seem strange to us now, in view of the several times previously recurring observations by some five different breeders, including those of Goss and Knight, of the phenomenon of the appearance of different coloured peas in the same pod as the result of crossing, that this phenomenon should not have aroused curiosity and led to experiments on Darwin's part, for he refers to them all. However, in view of the fact that neither Nägeli nor Focke—the only investigators before 1900 who were acquainted with Mendel's papers at all—was particularly impressed with the importance of *his* experiments with peas, it is not surprising that Darwin should, among others, have failed to find the clue that Mendel did.

However, as a contribution to the development of the history of hybridisation, Darwin's application of his doctrine of pangenesis is highly interesting, showing the operation of an able mind, in the absence of adequate experimental data, in framing a conception of a theory of hybrids that comes surprisingly near being a statement of the present point of view as regards operation and, in the case of homozygosis, in regard to theory as well.

HERBERT F. ROBERTS.
Department of Botany, Kansas State Agricultural College, June 24.

Wild Birds and Distasteful Insect Larvæ.

DR. W. E. COLLINGE gives in NATURE of July 24 some most interesting details about the distastefulness of insects to birds. He observes that both the larva and imago of *Abraxas grossulariata* are eaten by various species. I would like to add the following observations:—During the last few years I have bred several thousand larvæ, including those of *A. grossulariata*, in order to study their genetics. Owing to the impossibility of setting all the imagines, a certain number were set free as soon as recorded. In this way I have thrown out of my window imagines of the following species:—*A. grossulariata, Spilosoma mendica* (larvæ and imagines), and both type and melanic forms of *Tephrosia consonaria, Boarmia consortaria,* and *B. abietaria*. I have noticed the following points:—(1) The birds round the house, chiefly sparrows, would eat the imagines of all five species, but *A. grossulariata* the least readily, tearing off the wings and devouring the body on the spot (it was too late in the year for them to be feeding young). (2) My larvæ of *S. mendica* were suffering from a disease (a filter-passer, I believe, for smears revealed no micro-organisms), and when an entire brood was past hope I used to throw them into the garden. Some were dead and many dying, but they were cleared away in a few minutes, in spite of their evil smell. (3) The imagines of *B. consortaria* and *B. abietaria* were eaten with the utmost avidity. No sooner had one or two insects been thrown out than a number of birds would crowd round waiting for the next, and if this were hidden in the ivy round the house they would hunt for it until it was found. On one occasion some insects were hidden in a flower-pot on the window-sill, but the birds soon found them, and would afterwards return to the edge of the pot, as if waiting for more. These birds would even carry off dry pinned insects, possibly for their nests. The fact that birds will not eat *A. grossulariata* readily, but will eat the diseased larvæ of *S. mendica*, seems to support Mr. Speyer's view, especially since the parasites mentioned do not live in the alimentary tract. For this reason they contain no proteolytic enzymes, and can therefore be of no conceivable harm to young birds.

Observations as to the extent to which birds prey upon the imagines of various species have a special interest, because those theories of mimicry which are based on natural selection demand some conscious selective agent such as birds, although there are very few actual observations to support such a conclusion. Evidence concerning European species is, of course, only of value by analogy.

H. ONSLOW.
3 Selwyn Gardens, Cambridge, August 2.

THE BRUSSELS MEETING OF THE INTERNATIONAL RESEARCH COUNCIL.

THE Inter-Allied Conference on International Organisations in Science, which met in Paris on November 26–29, 1918, adopted a number of resolutions for constituting such organisations for the promotion of co-operation in scientific work, and appointed an executive committee to carry them out until the scheme was sufficiently advanced for the International Council to be convened and to assume its final form as a federation of National Research Councils.

This took place at a meeting which was held in Brussels on July 18–28, where the following countries and dominions were represented by their delegates: Belgium, Canada, France, Italy, Japan, New Zealand, Poland, Rumania, Serbia, the United Kingdom, and the United States of America.

On the morning of Friday, July 18, the delegates met in the Palais des Académies, where King Albert was present. M. Harmignie, the

Minister of Science and Arts, welcomed them in a short address in which he dwelt on the importance of the occasion and on the valuable results which would be obtained from international co-operation in science, and wished them success in their deliberations.

M. E. Picard, the president of the Executive Committee, was unfortunately prevented by ill-health from being present, and M. A. Lacroix presided at the meetings of the General Assembly. The first business was the consideration of the statutes of the International Research Council which had been provisionally agreed upon in Paris, and now came up for consideration in the final form as recommended by the Executive Committee.

The objects of the Council are therein defined to be:—

(a) To co-ordinate international efforts in the different branches of science and its applications.

(b) To initiate the formation of international associations or unions deemed to be useful to the progress of science.

(c) To direct international scientific action in subjects which do not fall within the province of any existing association.

(d) To enter, through the proper channels, into relations with the Governments of the countries adhering to the Council to recommend the study of questions falling within the competence of the Council.

The countries adhering to the Council are those already mentioned as represented by their delegates as well as Brazil, Australia, South Africa, Greece, and Portugal—that is, those of the Allied nations who were originally invited to form the International Council as possessing academies of science, and being engaged in scientific work. To these, other nations may be added at their own request or on the proposal of a country already belonging to the Council, or Union, by a three-fourths vote in favour of admission.

The work of the Council will be directed by the General Assembly, which will meet ordinarily every three years, but in the interval between its successive meetings business will be transacted by an Executive Committee of five members nominated by the General Assembly and holding office until the next meeting of the General Assembly. In the present case the Executive Committee, consisting of Prof. E. Picard, Dr. A. Schuster, Profs. Hale, Volterra, and Lecointe, has been re-elected and will consider its character and constitution and report to the next meeting of the General Assembly before its organisation is finally laid down.

The concluding meeting of the Council was held on Monday, July 28, when it was decided that all neutral nations should be invited to join the International Research Council and the International Unions created under its auspices, thus providing for the reconstitution of international scientific associations so far as is practicable at the present time.

The formation of unions for the organisation of international work and co-operation in different departments of science, which had been initiated at Paris, was carried considerably further at Brussels. In some cases unions with sections for dealing with special branches of the field covered by the union were organised. In other unions the delegates present came to the conclusion that at the present stage it was preferable to appoint committees to study the general position, and to report later to the union with a view to the formation at its next meeting of such sections as might be needed, when the representatives of the different countries would be better able to estimate their requirements.

The Astronomical Union, which was instituted in Paris, was now able to complete its organisation by approving its statutes, and by deciding upon the appointment of a number of committees for organising international co-operation in various branches of astronomical work, such an arrangement being considered better than the formation of separately organised sections. M. Baillaud was nominated president, and Prof. A. Fowler general secretary, of the union.

The Geodetic and Geophysical Union, which was also instituted at Paris in November last, includes several branches of science for which special organisations have existed for many years before the war. These have now been reconstituted as sections of the union, each with its own executive committee of international delegates. The statutes of the union, which follow generally those of the Council, were approved, and sections were formed for geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography, and vulcanology. The section of geodesy takes the place of the International Geodetic Association, now non-existent, but which formerly had its bureau at Potsdam. The triennial meetings of this association, at which reports on different kinds of geodetic work were presented and new methods and plans for work discussed, were of the greatest value to geodesists, and the new section has a large field of work before it. Variation of latitude was formerly included among the subjects grouped under geodesy, but at Brussels it was agreed that it would be more conveniently dealt with by the Astronomical Union, which appointed a committee to consider and report upon this subject. Major W. Bowie, of the U.S. Coast and Geodetic Survey, was nominated president, and Col. Perrier, of the Service Géographique de l'Armée at Paris, secretary of this section.

In seismology the old pre-war association is still in being until April 1, 1920, since the countries belonging to it did not withdraw from it before the commencement of the last four-year period. Its central bureau was at Strasburg, which is now a part of French territory, and Prof. Rothé has been appointed professor of geophysics there. It was decided, therefore, that no definite action beyond the institution of a section of seismology should be taken until the

old association had ceased to exist. The proposal was made at Paris that a section of the union should deal with meteorology, and this has now been confirmed, Sir Napier Shaw being nominated president, and Dr. Marvin, of the U.S. Weather Bureau, secretary. There has been for many years an International Committee of Directors of Meteorological Services, by whom administrative and technical questions relating to their work were discussed and international co-operation in that work was arranged. There is, however, ample scope for an organisation to co-ordinate work in meteorology, and to direct international work in the subject which does not fall within the administrative requirements of the meteorological services.

International work in terrestrial magnetism has hitherto been looked after by a sub-committee appointed by the International Meteorological Committee, but there was a general agreement that this subject and the electrical phenomena of the atmosphere should be dealt with by a special section which would co-operate with that dealing with meteorology and with the Physical Union in its work. Of this new section Prof. A. Tanakadate and Dr. Bauer, of the Carnegie Institution of Washington, were appointed respectively president and secretary.

To these sections were added two new ones—that of physical oceanography, to deal with tides, currents, temperature, density, salinity, and other physical phenomena of the oceans; and that of vulcanology for the study of the chemical and physical phenomena of volcanoes. In oceanography no president was nominated, but Prof. H. Lamb was elected vice-president, and Dr. Magrini, of the Hydrographic Service of Venice, secretary. In vulcanology the president is Prof. A. Riccò, of the Etna Observatory, and Dr. Maladra is secretary.

The executive committee of each union consists of a president, the presidents of its sections as vice-presidents, and a general secretary. In the Geodetic and Geophysical Union M. C. Lallemand, director of the Service de Nivellement de France, was elected president, and Col. H. G. Lyons general secretary.

The Mathematical Union was formed with Prof. Ch. de la Vallée-Poussin, of Louvain University, as president. In this union no sections have been formed, but it was agreed that the union should meet in Strasburg next year, when the further organisation of the union might be considered.

A Chemical Union was also formed, but the representation of this subject at Brussels was not sufficient to proceed further with its organisation there. The delegates representing physical science decided to form the Physical Union, leaving its complete organisation to a later occasion. An organising committee was nominated and charged with making arrangements for the next meeting as well as for forwarding various projects of importance for the progress of physical science.

In biology Prof. Yves Delage was elected president, and M. C. Flahault secretary. Sections were established for general biology, physiology, zoology, botany, applied biology, and medical science, but here, too, it was recognised that the arrangements made could only be provisional.

Though the practical success of the International Research Council and the unions associated with it cannot be fully demonstrated until the next meeting, when three years' work will be available for report, and there will have been time to prepare projects for international working in each group, the organisation is now established on a working basis, and the meeting at Brussels showed that there was a large amount of work to be taken up, for the organisation of which the executive committees of the unions and sections now exist. The meetings in London, Paris, and Brussels form successive stages in this important achievement, and the members of the executive committee who have guided the Research Council through the first stages of its existence may well be satisfied with the result.

The legal domicile of the International Research Council will be at Brussels, and the periodical meetings of the General Assembly will take place there. The secretariat will continue to be in London, where the Royal Society has placed a room at its disposal. Unions and sections will meet at such times and places as their general assemblies or executive committees may decide.

On the day of their arrival the delegates were received at the Hôtel de Ville by M. Adolf Max, and receptions were given by the Minister of Science and Arts on July 26, and by the Minister of Foreign Affairs on July 28, at their official residences. On July 26 M. G. Lecointe, director of the Royal Observatory, invited the delegates to visit the observatory at Uccle, where they were shown over the buildings and its ample instrumental equipment. H. G. L.

THE BOURNEMOUTH MEETING OF THE BRITISH ASSOCIATION.

IT is now possible to give further details of the meeting of the British Association to be held at Bournemouth on September 9–13. As already stated, practically all the meetings and discussions will be held in the Municipal College. This building, it is anticipated, will provide ample accommodation for all the activities of the association, with the exception of the very large assemblies—the inaugural general meeting, the discourses, and the conversazione (or, as it is now termed, the civic reception). It will readily be seen that in this respect members will find the arrangements far more convenient than at many previous meetings, when various buildings scattered over the town have had to be utilised.

The large hall of the college will be fitted up as the reception room. Other parts of the building will be converted into section rooms, staff rooms, luncheon and tea rooms, writing and smoking rooms, telephone room, etc. Members

may be assured that they will find every convenience and comfort immediately at hand. Only in the problematical case of an exceptionally large sectional meeting will it be necessary to make use of another building.

It is unnecessary in this article to describe in detail the long programme of work, a copy of which can be obtained from the headquarters of the association. The journal, giving full particulars, will, as usual, be issued daily throughout the meeting. The general public will probably be most interested in the papers and discussions relating to scientific work in the war, on such subjects as tanks, submarine mining, the paravane, air photography, the progress of aviation, airships, and directional wireless. Of special topical interest will also be the discussions arranged by the Economics Section on the National Alliance of Employers and Employed, price-fixing, with special reference to Australian experience, transport, finance and taxation, and the gold standard; by the Agriculture Section on war-time food production; by the Physiology Section (jointly with that of Economics) on the influence of the six-hour day on industrial efficiency and fatigue; by the Education Section on various problems of modern education; and by the Geography Section on long-distance air routes, the geography of Imperial defence, frontiers in the East of Europe, and the colonisation of Africa.

Following the precedent set in Birmingham in 1913, citizens' lectures will be delivered in outlying parts of the town during the week, in co-operation with the Workers' Educational Association. These will comprise lectures by Prof. H. H. Turner on "Modern Astronomy," Prof. S. H. Reynolds on "Purbeck Isle and its Geology and Scenery," and Prof. J. L. Myres on "Woman's Place in Nature from an Anthropological Point of View."

Numerous excursions will be made to places of interest in the neighbourhood. The Engineering Section will, by special permission of the Admiralty, visit the Royal Naval Cordite Factory at Holton Heath, a vast organisation which has sprung up during the war, and will also inspect the Bournemouth and Poole Gas and Water Works and the power stations of the tramways and electric light undertakings. The Geology Section will journey each afternoon to points of geological interest in the locality, including such favourite haunts of geologists as Lulworth Cove and Kimmeridge. The Botany Section will find much material for work and discussion in the New Forest, at Shell Bay, and elsewhere. The Agriculture Section is arranging a visit to Iwerne Minster, in the neighbouring county of Dorset; while the Anthropology Section will organise an excursion to the Channel Islands if sufficient names are received before the meeting. Communications on the last-named subject should be addressed to Dr. R. R. Marett, Exeter College, Oxford, who is to read a paper on recent discoveries of archæological interest in the Channel Islands.

It may also be mentioned that Lord Montagu of Beaulieu, president of the Conference of Delegates of Corresponding Societies, has offered to show members and their friends over the beautiful Beaulieu Abbey, with its thirteenth and fourteenth century remains; and Sir Merton and Lady Russell Cotes have consented to throw open to them the East Cliff Hall and its fine collection of art treasures.

From the social point of view, those attending the meeting will find the Bournemouth week a very pleasant one, even though official functions on a large scale are not contemplated. Various local clubs and institutions will be ready to receive them as honorary members during the period of the meeting, and in other ways a great deal will be arranged in the way of hospitality and entertainment.

SUBMARINE ACOUSTICS.

THE war has been responsible for great developments in many branches of science. As a consequence of the submarine menace, close attention has been given to the subject of marine physics, with the result that notable advances have been made in several directions, especially in that of submarine acoustics. Much of what has been accomplished is still regarded as confidential information, but some interesting disclosures have recently been made by Prof. W. H. Bragg in the Tyndall lectures delivered before the Royal Institution, and in a lecture at the British Science Guild's Exhibition at Westminster.

The singular property which distinguishes a submarine from other ships is its capacity of rendering itself invisible when pursued or when seeking and attacking its prey. Robbed of this power, it is an extremely vulnerable craft, and falls a ready victim to more heavily armed and armoured surface ships when once its presence has been detected and its position located.

The acoustic method of detecting a submerged submarine moving in the open sea was found to be far more sensitive and to give a much longer range than all other methods. Instruments used for this purpose are called hydrophones. Many varieties of hydrophone have been evolved and perfected, but by far the largest class consist essentially of a microphone attached to a diaphragm which forms one wall of a watertight cavity. The microphone is connected through a suitable electrical circuit to ordinary telephone receivers, the complete installation resembling a unit of an ordinary land telephone system. In use the hydrophone is suspended from the bulwarks of a stationary ship, or mounted in tanks attached to the hull, or trailed behind in a suitable "fish" body in the case of a moving ship. The range of a hydrophone depends upon the size and speed of the source of sound, the depth and state of the sea, the presence of other sources of sound, etc., and may vary from a few hundred yards to several miles.

The difficulty of ascertaining the *direction* of

a source of sound has been overcome in a number of ways. One type of directional hydrophone is shown in Fig. 1. In this instrument *both* sides of the sensitive receiving diaphragm are in contact with the sea, the microphone being encased in a small capsule at the centre of the diaphragm. If used in this form the instrument is deaf to sounds in its equatorial plane, but can hear sounds coming from other directions. It is, in

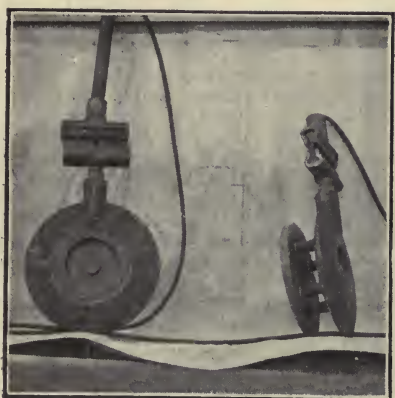

FIG. 1.—Uni-directional hydrophone.

fact, the reciprocal of the hypothetical "double source" of Helmholtz. The polar curve, showing the dependence of its response upon its orientation with respect to the source, is given in Fig. 2.

It is obvious that the ambiguity involved in the *bi-directional* qualities of such an instrument would seriously diminish its efficiency in actual practice, and accordingly a modification was introduced to eliminate this defect. This consisted in

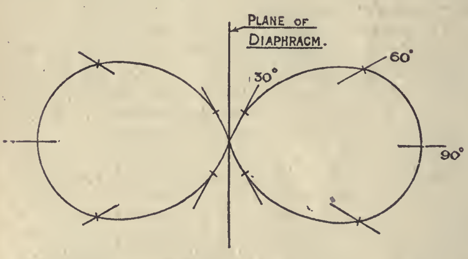

FIG. 2.—Direction-sensitiveness polar curve of a bi-directional hydrophone.

the attachment to the hydrophone carcass, at some distance away from the sensitive diaphragm, of a bias plate, or "baffle," as it is now called. This can be seen in the side view of Fig. 1. When correctly adjusted in position, the "baffle" modifies the polar curve of Fig. 2, so that it takes the form shown in Fig. 3, and, as can be readily seen, renders the hydrophone *uni-directional.*

The construction and properties of "baffles" are very interesting, and have been the subject of prolonged investigation. The mathematical theory of their action has not been worked out fully, as it is difficult to specify all boundary conditions. Moreover, the phenomena are of the diffraction type, in which the obstacle is small compared with the wave-lengths of the incident disturbances. A fairly complete empirical knowledge of their properties has, however, been obtained. The essential feature of their construction is the inclusion of a film of gas in a non-resonant enclosure. If the "baffle" is placed too close to the receiving diaphragm, the hydrophone becomes non-directional, a limiting case being that in which one side of the diaphragm is completely enclosed, and, therefore, "over-baffled."

In his lectures Prof. Bragg also briefly described two other methods by which the direction of an under-water source of sound could be ascertained by making use of a number of hydrophones which do not themselves possess intrinsic directional properties. In the first of these use is made of the binaural principle. Two hydrophones are mounted on a rotating arm at a dis-

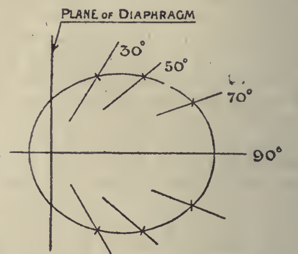

FIG. 3.—Direction-sensitiveness polar curve of a uni-directional hydrophone.

tance apart of from six to eight feet, one hydrophone being connected to the right ear-piece of the observer's telephone, and the other to his left ear-piece. If now the wave-front of the oncoming sound strikes the right-hand hydrophone first, the sound appears to come from the observer's right. On rotating the arm the hydrophone on the left side can be advanced so that the sound appears to come from the left. By rotating the device until the sound appears to come from ahead or astern, the observer is enabled to detect the direction of the source, a simple rule enabling him to resolve any fore-and-aft ambiguity. Instead of rotating the arm carrying the hydrophones, the angle which the wave-front makes with it can be found by compensating for the difference of path in water by introducing an equivalent length of air column between one or other of the observer's ear-pieces and his ear. In this case three hydrophones have to be used in pairs in order to obtain the direction of the source uniquely, the bearings being read off from the calibrated scale of the "compensator."

The second method consists in making use of

the phase relationships between a number of hydrophones distributed at regular intervals in a straight line. It is obvious that in this case sound-waves from a distant source arrive in phase only when it is situated on the beam of the line of hydrophones. By making use of a multiple "compensator" the phases can be corrected for all directions, and the bearing of the source read off from the "compensator" when the observer has determined the setting for maximum intensity.

One gratifying feature of the work on submarine acoustics done during the war is the possibility which it provides of rendering navigation more safe in times of peace. Used in conjunction with suitable sound signalling apparatus fitted to vessels, and submarine bells moored near dangerous shoals and rocks, the improved hydrophones developed for war service should greatly reduce the dangers of collisions and shipwreck, due to fog, etc.

Already hydrographic surveys of the North Sea are being carried out in which the position of danger spots are located for charting purposes by exploding depth charges and recording the resulting disturbances at a number of hydrophones connected to land stations. This method of submarine sound-ranging is by far the most accurate method of locating such spots, and also provides a means of enabling a ship at sea to obtain its correct bearings. By dropping a bomb hundreds of miles at sea, a ship can in a few minutes communicate its position to the nearest shore station and receive this information itself back again by wireless.

F. Lloyd Hopwood.

POWER ALCOHOL.

THE annual importation of petrol into this country rose to more than 100,000,000 gallons before the war. Most of this came from the United States. At that time the consumption in the States was about ten times this figure, but in 1919 will probably prove to be not less than thirty times as much. With these values to face it is impossible not to wonder whether the rapid expansion of usage in the States will allow the exportation—at any practicable price—of even the small relative quantity used in the United Kingdom before the war, to say nothing of any additional supply to meet the growth of our own needs for road, sea, and air.

These considerations suffice to render inquiry into the subject a matter of immediate moment, but there is an additional argument available to those who take a longer view. Any fuel product drawn from oil wells or coal mines has the nature of a fortunate dip in a "lucky bag." No one knows how long such supplies will last, nor what untapped stores there yet may be (nor where they are). Moreover, their renewal is a matter of hundreds, if not thousands, of thousands of years. For this reason it is wise for mankind to prepare to supply its future needs by drawing on the current account of the sun's radiant energy and to touch the capital as little as may be.

In most previous discussions on this subject it has been assumed that alcohol obtained from the potato crop is as feasible a source of supply as any that could be named. It now appears from the investigations of the Inter-Departmental Committee on Power Alcohol (Cmd. 218, 1919, price 2*d.* net) that whilst potatoes yield 20 gallons of alcohol per ton, the sun-dried flowers of the Indian mahua tree (costing about 30*s.* per ton delivered at the factory) will yield as much as 90 gallons of alcohol per ton. Here, as in so many other cases, it seems that raw material comes most abundantly and most economically from the tropics, which, indeed, in the present instance is not to be wondered at, seeing that it is the daily solar radiation the energy of which it is desired to tap.

The Government Committee above mentioned, with most praiseworthy energy, has also taken a decided step forward in probing the problems relating to the best use of the alcohol when produced. With this in view it has arranged with the London General Omnibus Co. for a complete fleet of motor omnibuses to be run for six months on both alcohol-benzol and alcohol-benzol-petrol mixtures, and for the results to be compared with running on petrol or other fuel. To use alcohol without any admixture might prove difficult owing to its reluctance to fire in a cold engine; moreover, for good thermal efficiency a high-compression pressure would be needed, and this again makes starting difficult. That, however, is but one of a series of problems which the Committee has arranged to have investigated at Manchester in the laboratory of Prof. H. B. Dixon, whose work on similar lines is well known. Both these investigations—scientific and commercial—should begin to bear fruit very shortly, and by Christmas it may not be too much to hope that the Committee will be able to publish information of such value as to enable the Government to take definite steps towards rendering power alcohol available for all internal-combustion engine users.

THE FORESTRY BILL.

THE Forestry Bill came before the Commons in Committee of the whole House on August 8, when amendments to several of the clauses were suggested. An important amendment increased the number of Commissioners from seven to eight, with the object of having one unpaid Commissioner sitting in the House of Commons, thus enabling the House to keep itself acquainted with the progress of the afforestation work. This amendment was agreed to, as was also another by Major W. Murray that not fewer than two of the Commissioners should have special knowledge and experience of plantation and forestry in Scotland.

Sir Philip Magnus strongly advocated the view put forward by the British Science Guild that at least one of the Commissioners should be a person

of scientific attainments having a technical knowledge of forestry. This amendment was rejected on a vote, but Sir Philip persisted with it in the Report stage, which followed immediately after Committee was over, and it was then accepted and added to the Bill. He also put forward an amendment, which was accepted, that the Commissioners should have power, in addition to collecting and preparing forestry statistics, to publish and distribute them.

From the point of view of assuring that the new Forestry Authority should have expert guidance in inaugurating and formulating its forest policy, the acceptance of Sir Philip Magnus's amendment with reference to the inclusion of expert scientific opinion on the Commission is of the very first importance, for on that member will lie a heavy responsibility. It is to be hoped that in his selection the Commissioners will make every effort to secure a man of recognised scientific attainments and merit, who at the same time possesses a wide knowledge of up-to-date forestry methods as existing in the different forestry services in the world. The appointment will not be an easy one to fill.

To those acquainted with the requirements of a truly scientific forestry department, the setting up of which is arrived at in this country, Sir Philip's other amendment, with reference to the publication of forestry statistics, which was also urged by the British Science Guild, is of not less importance. The publication of the material collected in proper form—that is, in a form which shall comprise the issue of that collected in a separate series of publications, some for the scientific reader, and others for the lower grades of a forestry service and for laymen—is a matter of supreme importance. This importance is accepted by the man of science without question, but to the public the value of such reports is not self-evident. In this respect, therefore, the House of Commons is to be congratulated on possessing at least one Member having the knowledge and foresight to recognise the vital necessity of assuring that this aspect of the question is safeguarded, and to be an advocate of scientific interests generally. After passing through Committee the Bill was read a third time.

NOTES.

THE following names appear in the deferred list of honours in connection with the King's birthday, which was published yesterday:—Viscount Iveagh, chancellor of Dublin University (promoted to an earldom); Lt.-Col. H. G. Barling, vice-chancellor of Birmingham University, and Mr. C. H. E. Chubb, donor to the nation of Stonehenge (baronetcies); Dr. R. C. Brown, founder of a scholarship for research at Cambridge University, Prof. W. Boyd Dawkins, F.R.S., and Mr. J. Y. W. MacAlister, president of the Library Association and secretary of the Royal Society of Medicine (knighthoods).

THE Pontécoulant prize of the Paris Academy of Sciences has been awarded to Prof. A. S. Eddington for his work on astronomical research.

AN important demonstration in wireless telephony was given by the Royal Air Force in the Houses of Parliament on Monday, August 11. So far as can be judged from the Press accounts, the demonstration was entirely successful, over a range of twenty miles. General Seely explained that the Air Force took up the subject of wireless telephony early in 1915, and by March, 1918, the first two squadrons of aeroplanes had been fitted with the apparatus, which gave them such an advantage that it was found that German machines took care to avoid them. The postal aeroplanes, such as those plying between Kenley and France, are now so fitted. Ranges of 100 miles from an aeroplane and of 165 miles from an airship have been obtained, and could be increased by the use of larger aerials at the receiving stations, if any good purpose would be served thereby. Improvements still remain to be effected, such as the elimination of the trailing aerial on the aeroplane, and of the need of switching over between sending and receiving, which makes the interchange of conversation not quite so easy as it is with an ordinary telephone. Another part of the demonstration concerned direction-finding by wireless for the navigation of aircraft. For this purpose the aerial in the aeroplane takes the form of a coil of wire mounted on a rectangular frame about 4 ft. high and 3 ft. wide, which can be turned on a vertical axis, and the variations in the strength of the signals as this is turned round enable the direction of the sending station to be located. A coil of this kind was on view, and by its aid signals were picked up from the Eiffel Tower, a portion of a message received announcing itself as being an "order particularly for Budapest." An inter-communication telephone was also shown by General Seely. Worn on the neck of a member, with a wire-connection down the trouser-leg, it would enable him to speak to all the world.

IN a letter published in the *Times* of August 4 Prof. Karl Pearson directed attention to the serious financial difficulties of the Galton Laboratory. Owing to the war the equipment of the buildings provided for the housing of the laboratory staff was not proceeded with, and the institute was used as a military hospital. Now, owing to the rise in prices, not only will the equipment cost from two to three times as much as it would have done in 1914, but the slender endowment is quite inadequate to defray ordinary establishment charges, the cost of printing, and the provision of a living wage for the staff. Prof. Pearson writes:—"The Biometric and the Galton Laboratories were the first of their kind to be established; they no longer stand alone. The United States have their professors of biometry and their eugenics laboratories backed by funds which we cannot hope to rival. Why is it that Britain so often starts the new idea but leaves it to fructify in other lands? Especially important at the present moment is the field of activity for our science. The war has brought many problems to the fore; eugenical research has much ground to make up, and most serious questions as to national efficiency are demanding scientific treatment." This reasoning is cogent, and it will be a serious scandal if the Galton and Eugenics Laboratories are starved. The enlightened patronage by the State of research institutes maintained in connection with universities is nearly always a better method of promoting the true interests of science than the segregation of research workers in State Departments out of touch with the general developments of academic thought.

WE regret to have to record the death, at the early age of forty-three, of Prof. George Stephen West, holder of the chair of botany and vegetable physio-

logy in the University of Birmingham since 1909. Prof. West's work in algology has a world-wide reputation, and under him the botanical department of the University had reached the first rank for the study of this branch of botany. His death while still a young man not yet at the zenith of his power is an irreparable loss to the University of Birmingham, and deprives the world of a botanist of first-rate ability, whose recent work on the algæ of the soil opens up a new field of investigation the economic importance of which is likely to be far-reaching. Prof. West was an indefatigable worker and an admirable director of research, admired and warmly appreciated by his students and colleagues. Though robust in appearance, he had recently been in indifferent health, and an attack of pneumonia ended fatally on August 7. He leaves a widow and two children.

THE death is announced, on August 8, at the age of eighty-five years, of Prof. Ernst Haeckel, of the University of Jena.

BY the death of Mr. Andrew Carnegie, on August 11, in his eighty-fourth year, a romantic career was brought to a close, and the world lost probably its most generous contributor towards the promotion of science, education, art, and other objects, for Mr. Carnegie held strongly that the possession of wealth carried responsibilities, and that "surplus wealth was a sacred trust which its possessor was bound to administer in his lifetime for the good of the community." He held that "it is a crime to die rich." Acting on these principles, he set himself to disburse his immense fortune to further enterprises which appealed to him. How much he distributed is not known, but in 1908 it was estimated that he had given more than 57,000,000*l.* in America, more than 7,000,000*l.* in Great Britain, and 1,000,000*l.* in Europe. Among his gifts may be mentioned 5,000,000*l.* to the Carnegie Institution of Washington, 2,000,000*l.* to inaugurate the Carnegie Institute at Pittsburgh, 2,000,000*l.* towards university education in Scotland, 50,000*l.* to the University of Birmingham, and, it is estimated, 10,000,000*l.* towards libraries alone. He also purchased the famous library of the late Lord Acton, which, through Viscount Morley, is now the property of the University of Cambridge. Mr. Carnegie was Lord Rector of St. Andrews University in 1903–7 and of the University of Aberdeen in 1912–14, and was the recipient of the honorary degree of LL.D. from the University of Cambridge.

THE death is announced of Mr. Herbert Ward, a traveller in many lands and a member of the rear-guard of Stanley's Emin Pasha Relief Expedition.

MR. CARLE SALTER, of the British Rainfall Organisation, has been awarded the premium of the president of the Institution of Water Engineers for his paper on "The Relation of Rainfall to Configuration," which was read before the institution in December last.

DR. SHAIFFER, of the University of Toronto, has been appointed expert in animal husbandry to the Government of Mysore. He will work under Dr. Coleman, the director of agriculture.

A DEPARTMENTAL Committee has been appointed by the President of the Board of Trade to investigate and report upon the present position and economic possibilities of non-ferrous mining in the United Kingdom, and to make recommendations as to such Government action as may be expedient in regard thereto. The members of the Committee are Mr. H. B. Betterton, M.P. (chairman), Mr. H. F. Collins, Mr. J. Harris, Dr. F. H. Hatch, Sir Lionel Phillips, Bt., Mr. R. A. Thomas, and Mr. James Wignall, M.P. All communications should be addressed to the secretary, Mr. W. Palmer, Gwydyr House, Whitehall, S.W.1.

WE are asked to announce that the time for accepting entries for the Cammell Laird scholarship in naval architecture and the Parsons scholarship in marine engineering of the Institution of Naval Architects has been extended to August 31. Application forms may be obtained from the secretary, Institution of Naval Architects, 5 Adelphi Terrace, Strand, W.C.2.

As already announced (NATURE, July 10, p. 370), the Royal Society will in the coming autumn elect to two John Foulerton studentships for original research in medicine, the improvement of the treatment of disease, and the relief of human suffering. The latest time for the receipt of applications (which should be addressed to the Assistant Secretary of the Royal Society, Burlington House, W.1) is October 31.

A WAR section of the Royal Society of Medicine has recently been formed having for its object the dealing with questions affecting medicine and surgery in the Navy, the Army, and the Air Force. The first meeting of the section will be held on Monday, November 10, when the president, Sir Robert Hill, Medical Director-General, R.N., will give an address.

LORD WEIR has consented to open an Exhibition of Shipping, Engineering, and Machinery which is to be held at Olympia for three weeks, beginning on September 25 next. It was to have been held in 1914, but was postponed in consequence of the war.

A MEMORIAL tablet to Sir Walter Ralegh—the gift of the Société Jersaise—has been placed on the wall of the States Chamber of Jersey, Sir Walter having been Governor of the island from 1600 to 1603. In unveiling the tablet the Bailiff of Jersey said that of all the distinguished men who had been connected with the Channel Islands none had been more remarkable than Ralegh, who was one of the group of Devon men who had conceived the magnificent idea of the British Empire.

THE Department of Mines and Industries of the Union of South Africa is requiring the services of a scientific officer for the Fisheries and Marine Biological Survey of the South African coast. The duties of the officer will be to superintend operations, chiefly on board surveying vessels, connected with sounding, dredging, trawling, physical observations, the pressing of specimens, etc. Applications should be sent, in duplicate, not later than September 15, to the High Commissioner for the Union of South Africa, 52 Victoria Street, S.W.1.

THE Government has issued as a White Paper (Cd. 280, 1919) a report on the food conditions in Germany by Prof. E. H. Starling, supplemented by memoranda on agricultural conditions and statistics by Messrs. McDougall and Guillebaud. Prof. Starling shows very clearly that the chief cause of the collapse was a food policy erroneous in principle and unworkable in practice. So late as 1917–18 the total available food, after meeting the needs of the Army, would, if equally divided, have sufficed to provide 3000 Calories per average man; but, owing to failure to control producers, the distribution was altogether inequitable. The producers continued to consume their pre-war ration, nearly 25 per cent. of their disposable surplus was estimated to be distributed by illicit trade—to the advantage, of course, of the wealthy—and not more than 1500 Calories were left to be distributed as the average ration per man per

day. The result was that the brunt of the suffering had to be borne by the working-class and middle-class urban populations. Prof. Starling finds that the conditions are grave. Even under the most favourable conditions, and "if Germany is treated by the world as a sick child to be nursed back to health, it will take one, and perhaps two generations before she can recover her previous efficiency. After that, whether she is a danger or not to Europe depends on her Government. Her docile and industrious people are, at any rate, sickened of war, and represent no longer any active menace to the people of Europe." It appears that if Germany is to be in a position to utilise her full working capacity, she will need during the coming year imported food amounting to about a quarter of that normally imported into the United Kingdom.

AT the invitation of Sir Robert Hadfield some 200 representatives of the firm of Messrs. Hadfields, Sheffield, including directors, members of the technical, financial, and commercial staffs, the research department, managers, foremen, workmen, and boys, visited London recently to inspect the British Scientific Products Exhibition, at the Central Hall, Westminster, and the Science Exhibition, South Kensington. At a luncheon at the Central Hall Sir Robert Hadfield, who presided, said he was far from being a pessimist at the present time. Naturally the workmen, owing to higher prices prevailing, wanted higher wages. What was wanted was the exercise of more patience on both sides, and the recognition of the fact that the best way to gain one's ends was by the constitutional method of Parliament. That was the method which would, he was sure, commend itself most to the British working man. Sir Richard Gregory, chairman of the organising committee of the British Scientific Products Exhibition, said that the lesson to be learned from the exhibition was that modern civilisation demanded progressive work from science and from industry. After lunch a visit was paid to the Science Museum at South Kensington, where the party was joined by Prince Albert, who spent half an hour with them in looking over the exhibits. The Prince, who is chairman of the Industrial Welfare Society, expressed his pleasure at meeting such a happy lot of workers, and said he would be very glad to receive a copy of the essay which won the prize offered by Sir Robert Hadfield to the boy who wrote the best account of his visit to London.

KILDARE, the site of the nunnery of St. Brigid, was undoubtedly in pre-Christian times the site of a fire and solar sanctuary, and the traditions of the older establishment have in more than one respect coloured those of the later. In *Man* for August Prof. R. A. Macalister quotes an early story about Dar-Lughdach, a pupil of St. Brigid, who was smitten by unholy love for a man. An angel warned her in a dream to fill two shoes with hot coals and to walk shod therewith. The fire extinguished her ardour, and St. Brigid blessed her feet and the burns were healed. Prof. Macalister suggests that this legend is a tradition of the practice at pagan Kildare of the rite of the fire-walk. Starting with fragmentary recollections of a woman who walked on fire with unhurt feet, the legend would naturally assume its present form. The name of the heroine means "Daughter of Lugaid," but it is highly probable that this is a perversion or a by-form of Dar-Luga, "Daughter of Lug," the sun-god.

UNDER the title of "A Brief History of the Study of Greek Vase-painting" Mr. S. B. Luce, in the Proceedings of the American Philosophical Society (vol. lvii., No. 7, 1918), gives a useful summary of what has been done to elucidate the subject. A valuable addition to his paper is a classified list, by countries, of museums containing collections of vases, with accounts of the catalogues which have been issued. A study of this will probably lead to the discovery of other smaller collections which deserve attention, and will stimulate the curators of museums containing uncatalogued collections to supply the want.

IN the Report for 1918 on the Lancashire sea-fisheries laboratory at the University of Liverpool and the sea-fish hatchery at Piel, Prof. Herdman, Mr. Andrew Scott, and Miss H. Mabel Lewis give a short account of their intensive study of the marine plankton around the south end of the Isle of Man. One conclusion, they state, is becoming clear from the accumulated observations of the last ten years, and that is the surprisingly small number of different kinds of organisms which make up the bulk of the plankton that are of real importance in regard to fish. Seven genera of diatoms and six species of copepods are named in this connection, and particular attention is directed to one of the copepods, *Temora longicornis*, which was found in 1917 to be related definitely to the summer herring fishery off the Isle of Man. To the same report Dr. Johnstone contributes a summary of his investigations into the dietetic value of sprats and other clupeoid fishes, including a short discussion of the nature of the "maturation" which takes place when pilchards, herrings, sprats, etc., are "processed and packed *à la sardine*." When newly packed the bones are not softened, and the taste and smell not those expected; the ripening is the result of allowing the tins to stand unopened for a period of six months to four years, during which the fish continually improve in flavour and the bones become softened. Apparently nothing is known as to the nature of this maturation process, but bacterial action can be excluded. Dr. Johnstone suggests that it may be a process of autolysis due to specific intracellular enzymes normally present in the flesh of the fish, but on chemical examination the amount of amino-acids —which would be formed on the partial splitting of the protein—was found to be negligible. Further investigation is required to elucidate the nature of the process.

PROF. ARTHUR THOMSON gives an account (*Journ. of Anat.*, vol. liii., pts. ii. and iii., 1919) of his observations on the maturation of the human ovum, and holds that there is distinct evidence of the first and second polar bodies being given off while the egg still lies in the ovary within the discus proligerus of the Graafian follicle, and therefore before it has been subjected to the influence of the spermatozoon. This is contrary to the general rule, for in other vertebrates the sperm usually enters the egg during the second maturation division. The average size of the human ovum is, according to Prof. Thomson, $0{\cdot}11 \times 0{\cdot}095$ mm. (including the zona pellucida)—that is, considerably less than is generally stated.

LITTLE has hitherto been known of the Polyclad Turbellaria of the Japanese coasts, and the attention of workers on this interesting order may be directed to a paper by M. Yeri and T. Kaburaki (in Journ. Coll. Sci. Imp. Univ. Tokyo, vol. xxxix., December, 1918), recently received, in which are described twenty-six species referred to fourteen genera. Two new genera have been formed, and seventeen of the species are described as new. One of the latter belongs to the remarkable genus Bergendalia, and has the pecu-

liar duplicate male organ not connected with the vas deferens.

An article on "The Passing of the American Potash Famine," contributed by Prof. P. G. H. Boswell to the Journal of the Society of Chemical Industry (June 16, 1919), states that large quantities of potash will probably be delivered from Germany both to the British Isles and to America. This would seem to suggest that the new potash-obtaining methods introduced during the war are not producing sufficient supplies. In America the total production of potash for 1917 was 50,000 tons, against 230,000 tons imported before the war. Just before the National Exposition of Chemical Industries, held in New York in September, 1918, Russian potash was being used to some extent by the chemical industry, and in large quantities by the glass industry. This potash was obtained from sunflower plants, which were the chief source of fats for the South Russian peasantry. At first it realised as much as 90 cents per lb., but now it is sold with difficulty at 15 cents. Only a small quantity of this supply was permitted to be exported to Britain, until the restrictions were removed shortly before the armistice, when, too, our own supplies were better because of the new recovery process from blast-furnace flues. The greater part of the potash imported in the United States was used for fertilising purposes, and this is thought to have been the result of German propaganda work. Obviously the poor, sandy soils of northern Germany and our own much cultivated, and consequently exhausted, soils need potash far more than do the practically virgin soils of America. It is therefore probable that America will in future use far less potash for fertilising purposes, and, in consequence, the world's demand for potash will be much more easily satisfied.

The microscopic structure of coal has been a matter of scientific interest for the best part of a century, but it was in the year 1854 that the study was started with fresh vigour by Prof. John Quekett. Again in 1870 the subject was revived by Prof. Huxley in his article on "The Formation of Coal," and since then it has been approached from time to time, almost always with regard to its vegetable contents, and some papers by J. Lomas and others are still fresh in our minds. A paper recently published by Dr. Marie C. Stopes on "The Ingredients of Bituminous Coal" (Proc. Roy. Soc., B, vol. xc., p. 470, 1919) led one to expect some further light upon the botanical side of the question, but this paper attacks the problem from an entirely different point of view. "Coal is a rock," the author says, and may be studied in the same way that petrologists work at other rocks. The general structure of coal as seen in sections is described, and the *three* layers hitherto generally recognised are pointed out; but the bright layer is now divided so that there are four kinds of substance, for which names are proposed. Some account is also given of "The Behaviour of the Four Ingredients with Certain Chemicals."

Mr. J. Morrison puts forward a new view in a paper on "The Shap Minor Intrusions" (Quart. Journ. Geol. Soc., London, vol. lxxiv., p. 127, 1919) to account for the presence of corroded crystals of orthoclase and quartz in a magma of basic character. He suggests that differentiation into a granitic type above and a more basic type below occurred in a large body of molten rock, and that the crystals, as they developed in the upper levels, sank through the mass until they became incorporated in the basic portion, from which they could not have separated by ordinary processes of crystallisation during cooling.

Messrs. E. T. Wherry and E. Q. Adams ("The Classification of Mimetic Crystals," Journ. Washington Acad. Sci., vol. ix., p. 153, 1919) endeavour to get rid of the indefinite prefix "pseudo" in mineralogy, when a mineral crystallises in a form closely resembling that of a system other than its own. They describe quartz, for example, not as pseudohexagonal, but as cryptotrigonal and phenohexagonal, and other terms are introduced for cases where crystals compounded by twinning produce forms simulating a foreign degree of symmetry.

The *Annales* of the National Observatory of Athens (vol. vii., 1916) contains several papers by Prof. D. Eginitis and Messrs. E. Goulandris and N. Critikos on earthquakes in Greece during the years 1912–14. The total number of shocks recorded is 1366, giving an unusually high annual average for so small a country. Two destructive earthquakes (on January 24, 1912, and October 17, 1914) were felt over the greater part of Greece and ruined many places, the one in the south-east of Cephalonia and the north of Zante, the other in and around Thebes. Both occurred without any warning fore-shocks, and were followed by a large number of after-shocks (the Thebes earthquake by 712 within a year), several of them strong enough to add to the ruin wrought by the principal shocks. On November 23 and 27, 1914, and January 27, 1915, destructive earthquakes were felt in western Greece and the Ionian Islands, the epicentres being respectively near the south-east and north-west coasts of Santa Maura and the north-west coast of Ithaca. In a general discussion Prof. Eginitis states that, of the earthquakes registered at Athens from 1900 to 1914, 733 occurred during the night (6 p.m. to 6 a.m.) and 611 during the day; but he suggests that to prove the greater night-frequency, a longer series of records would be required.

The strong earthquake which disturbed the Midland counties on January 14, 1916 (Nature, vol. xcvi., 1916, pp. 572, 601), is described by Dr. C. Davison in the *Geological Magazine* for July (vol. vi., 1919, pp. 302–12). The earthquake occurred at 7.29 p.m., and was sensible over an area of about 50,200 square miles. It originated in two distinct foci, one about two miles north-east of Stafford, and the other about one and a half miles north-west of Eccleshall, the distance between them being eight or nine miles. The vibrations from the two foci coalesced along a narrow band crossing between them and at right angles to the line joining them. As this band is slightly concave towards the west, and lies nearer the western focus, it follows that the eastern focus was first in action, and that the impulse at the western focus occurred before the vibrations from the other had reached it. The earthquake was thus a twin earthquake. The relations between the Stafford earthquake and the twin earthquakes of Derby in 1903, 1904, and 1906, and those of Leicester in 1893 and 1904, are considered, and it is suggested that the crust at some depth must be corrugated in two systems of perpendicular folds about seventeen miles in wave-length.

Le Temps of August 27, in an article on the newly founded Institut d'Optique, gives some interesting figures on the growth of the optical industry in France during the war. These indicate that the output of instruments suitable for military purposes increased about ten times between 1914 and 1918. The supplies of optical glass did not present so great a cause for anxiety as in this country, for before the war, with

three optical glass factories in operation, the supplies were more than adequate for their domestic requirements. The output increased from 4000 kilos. a month in 1914 to 12,000 in 1918. The claim advanced in the article that this represents 80 per cent. of the total Allied production can scarcely be correct, as our own output during 1918 probably exceeded 9000 kilos. a month. Like ourselves, France was largely dependent before the war on German sources for supplies of the higher grades of optical instruments. She is determined that this position shall not recur, and has taken steps not only to safeguard her own supplies, but also to secure a share of the world market. As a means to this end, the Institut d'Optique, providing for higher instruction in optics, research and testing laboratories, as well as for the training of skilled glass workers and mechanics, has been founded. As the head of the institute she has been fortunate enough to secure Prof. Fabry, for whom it is proposed to create a chair of optics at the Sorbonne. The institute aims at fulfilling for the whole French optical industry the functions which, in Germany, the special technical staffs exercise for their own firms. The institute will receive annual subsidies from the Ministries interested in its work.

THE question is frequently raised in connection with the use of aluminium and its alloys whether they can be satisfactorily soldered; and, if so, by what method and with what metals and alloys. Aluminium and, to a less extent, its alloys can be welded quite satisfactorily by the oxygen-gas process, but often it is not desirable to heat the parts to be joined to the relatively high temperature necessary to weld them in this manner, owing to the resultant distortion of the parts, and a means of joining it at lower temperatures is sought. The U.S. Bureau of Standards accordingly, in its Circular No. 78, gives an account of special tests recently made at the Bureau to determine the general trustworthiness of aluminium solders. The most common of these consist of tin as a base, with the addition of zinc and aluminium, and sometimes lead, in moderate proportions. These metals and their combinations are electrolytically electro-negative to aluminium. A soldered joint is, therefore, rapidly attacked and disintegrated when exposed to moisture. There is no solder of aluminium of which this is not true. Such joints should, therefore, never be made unless they are to be protected against corrosion by paint or varnish. Solders are best applied without a flux after a preliminary cleaning and tinning of the surfaces to be soldered. The composition may be varied within wide limits. It should consist of a tin base with the addition of zinc or both zinc and aluminium, the chief function of which is to produce a semi-fluid mixture within the range of soldering temperatures. The tensile strength of a good aluminium solder is about 7000 lb. per sq. in. There is no reason why it need be brittle, as several commercial varieties are, and it is very undesirable that it should be. Its strength depends upon the type and workmanship.

IN consequence of the increased cost of production, the published prices of the *Observatory* and the *Companion* are to be raised to 1*s*. 6*d*. and 2*s*. 6*d*. respectively, beginning with the new volume.

THE Wireless Press, Ltd., will shortly begin the publication of a new monthly periodical entitled the *Radio Review*, which will be devoted to the scientific development of radio-communication and contain a review of all current wireless literature.

OUR ASTRONOMICAL COLUMN.

KOPFF'S PERIODIC COMET (1906 IV.).—This comet, an observation of which by Dr. Wolf was announced last week, has since been photographed at Algiers on August 4, and at Greenwich on August 6 and 7. In default of an ephemeris, an approximate place for a few days may be inferred from these observations:—

	G.M.T. h.	R.A. h. m. s.	S. Decl. ° ′
July 30 ...	10	19 27 12	9 32
August 4 ..	10	19 26 32	9 5·7
6 ...	10·6	19 26 24	8 57·1
7 ...	10·6	19 26 23	8 53·2

The comet was said to be of magnitude 10·5 on July 30, and 11·0 on August 7.

MAGNITUDE OF NOVA AQUILÆ.—The *Astrophysical Journal* for June contains a series of measures of the brightness of this star made by Mr. Stebbins and Mr. E. Dershem with the photo-electric photometer between June 9 and December 10 of last year, on seventy-eight nights in all. Noting the precision of the instrument, for the probable error of one observation is said to be of the order of a hundredth of a magnitude, this series might be accepted as standard. It shows an almost uniform decrease in the light of the star until June 30 to mag. 3·3. There was an increase of 0·2 mag. between the nights of July 1 and 3, a similar increase between July 22 and 27, and an outburst measured by 0·7 mag. between August 5 and 6. Later dates when the brightness increased were September 1–5 (0·4 mag.), September 19–21 (0·2 mag.), October 6–12 (0·3 mag.), and, except for these, the fall of brightness was slow but uniform until December 10, when the magnitude was 5·67. The authors say that they were disappointed not to detect any rapid changes of light. Although the measures often extended over four or five hours, there was only one night (June 10) when a variation so large as 0·10 mag. could be established, and the measures do not show any sudden and erratic variations in the course of an hour or so. It would, indeed, have been interesting if the large outburst between August 5 and 6 had happened in the course of an evening's observations. Most of the increases above mentioned have been recorded in other series of observations.

MASS AND MOMENTUM OF STELLAR SYSTEMS.—A memoir of the College of Sciences of the Kyoto Imperial University (vol. iii., No. 7, August, 1918) is useful, since it gives collected lists of binary and multiple stellar systems, with the determined elements of the orbits and the adopted parallax. From this data the authors, Messrs. Shinjo and Watanabe, have found that for all double and multiple systems the mass is of the same order of magnitude, being in the mean about one and a half times that of our solar system. For spectroscopic binaries of the A type the mass is found to be only slightly larger, but four spectroscopic binary systems of the B type have in the mean a mass twenty times that of our system. A similar research by Prof. Aitken recently showed that the visual binary systems were about twice as massive as our sun, and suggested that stars of classes K and M are less massive than those of classes A to G. The authors of the memoir now before us computed also the angular momenta of the systems, and found that, on the whole, this is of the same order of magnitude for all visual systems, being more than a hundred times that of our solar system. That the masses of the celestial bodies are, approximately, of about the same order of magnitude has already been

accounted for by theoretical considerations Messrs. Shinjo and Watanabe endeavour to show that the constancy of angular momentum results from the hypothesis that the celestial bodies have evolved from primordial swarms of meteorites.

THE DESIGN OF OPTICAL MUNITIONS OF WAR.

In a paper read before the Optical Society in January last,[1] Lt.-Col. A. C. Williams, the officer until lately in charge of the inspection of optical munitions at Woolwich, described in some detail the tests made by his department when inspecting the various optical instruments submitted by the manufacturers. The precedent thus set is a most useful one. It is common knowledge what an immense number of instruments were made and accepted, but it is not so generally known how stringent were some of the tests. Col. Williams makes no apology for the stringency of these tests, and in stating the conditions of service shows how different Army conditions are from those of civil life. They are indeed severe. "It must be remembered that Service instruments may be sent to any part of the world, and must remain serviceable when used in Arctic snows, Flanders mud, Mesopotamia heat and desert sandstorm, or after travelling in lorries for thousands of miles over bad roads. In some cases they are attached to guns, and have to withstand the shock of firing. It must also be remembered that they are not always used by men accustomed to handling delicate instruments, and that it is only on rare occasions that they can be sent to a workshop for repair." In addition to these considerations, that of weight is always present. As Mr. J. W. French in his interesting contribution to the discussion points out, it is easy to make an instrument to withstand severe shock tests if lightness is not of importance.

Interesting as is the description of the various tests made at Woolwich, the most interesting part of the paper is the glimpse given of the pre-war attitude of the Government Department to the scientific instrument maker.

Col. Williams assumes that the manufacturer by some uncanny instinct "should know what classes of instruments are required, and should submit to the authorities the highest class of designs of such instruments." The designs would then be considered by a committee of experts, who would criticise and decide on the most serviceable.

In the past the complaint of almost every manufacturer of scientific instruments has been the difficulty of learning what instruments were required by the Services and of obtaining detailed information of the particular problem. Secrecy was necessary during the war, but even then it was frequently insisted upon to an unnecessary extent. In times of peace it has the effect of holding back the development of new instruments. It is common knowledge how much Prof. Cheshire did to bring together the manufacturer and the officers testing and using the instruments when made. In the future it is essential that the designs of the Service instruments should be jointly considered by a body of experts, manufacturers as well as officers, so that instruments are not built up in the haphazard way they were in days gone by. It is not necessary to trace the evolution of an instrument by its obsolete excrescences or unnecessary parts It is essential, however, that the fundamental parts should be accurate, within certain specified limits, and that the experts should decide on those limits.

The Government must also be prepared to pay liberally for the manufacture of first models. In the future, with the aid of the National Physical Laboratory, the Institute of Technical Optics, the British Optical Manufacturers' Association, and the British Scientific Instrument Research Association, the Government Departments should not find it difficult to obtain good and generous technical assistance.

Robert S. Whipple.

[1] "The Design and Inspection of Certain Optical Munitions of War." By Lt.-Col. A. C. Williams, R.A. (Trans. Optical Soc., January, 1919.)

THE OUTLOOK OF METEOROLOGICAL SCIENCE.[1]

At no period in the sixty-nine years of the society's existence has the president had a wider range of choice for the subject of his address than at the present moment; and certainly never has the richness of choice been more of an embarrassment than on this occasion. The notable and welcome increase in the number of fellows adds to the responsibility of the situation. Whether we look backward over the days of war, or forward to the future and all that it may have in store for those who are interested in the study of weather, there is more than enough to occupy the time which tradition has placed at my disposal.

Looking Backward—The Position before the War—The Investigation of the Upper Air.

Looking backward, we must take account of a promise of remarkable activity in all branches of meteorology. Even if there had been no war, the last five years would have been fruitful years in the development of the science. The progress of aerial navigation, already begun in 1914, promised unexampled opportunities in the comparatively new study of aerography, in addition to those which meteorologists had previously made for themselves.

The Shock of War and the Reaction.

Thus the outbreak of war found the various meteorological agencies actively employed upon their own projects for the world's enlightenment, and its first effect was to paralyse a good deal of their activity. It cut our wireless communications, hampered our telegraphic reports, put shipping out of bounds, claimed our active workers and their possible substitutes for services that wore a uniform, and altered the whole balance of the complicated machinery which had been elaborated for our contribution to the world's stock of knowledge of the atmosphere.

The whirligig of time has brought its revenges. We are no longer allowed to regard the weather as a subject of curious inquiry that can be ignored in time of war. It has been borne in upon us that weather has its influence on the production, preservation, and transport of food; that it has a bearing upon the health of the community; that floods and droughts, sunshine and storm, such trivial circumstances as low clouds and fog, have their effect upon operations of offence and defence; and we have learned in the school of experience that aerial navigation may be attended with danger to others beside the navigators.

The Call for more General Knowledge of Meteorological Methods and Results.

The quickened interest in the study of weather for all purposes has expressed itself in the creation of a number of special establishments for the Naval Air

[1] From an address on "Meteorology: The Society and its Fellows," delivered before the Royal Meteorological Society on January 15 by Sir Napier Shaw, F.R.S., president of the society.

Service, for the Navy itself, for the Army, and for the Royal Air Force.

Throughout the whole course of the war we were constantly reminded that what was standing in the way of an effective use of past experiences of weather in all parts of the world was a lack of general knowledge of the common methods of meteorological study and of the principles deduced by their aid. Until this position is secured, every letter in reply to a simple inquiry must be prefaced with an explanation of what you mean by an isotherm, an isobar, the exposure of an anemometer, and even the difference between the points of the mariner's compass and the geographical orientation, and every popular lecture must begin, and generally has to end, with a recitation of rudimentary ideas.

The Preliminary Training Required for a Professional Career.

Here, perhaps, it is desirable to make it clear that the practice of the science of meteorology includes the process of observing, of the first part; the compilation and summarising, in maps or otherwise, of the facts of weather, of the second part; the application of meteorological principles, which includes the forecasting of future weather, of the third part; and the development of the science of meteorology, of the fourth part. Any one of the first three may be pursued according to recognised canons of procedure with satisfactory results; every one of them is indispensable, and history is my witness that all three of them may be pursued simultaneously without any effective recognition of the fourth part, which forms our only avenue to the comprehension of the secrets of the sequence of weather.

In the present position of meteorological science there are two extremes of opinion: either to think the penetration into the secrets of the subject to be so difficult that we must be content to forgo the attempt and deal with what we have, or to think it so easy that only observations are required and the training of our brains is of no account. Both these extremes ought to be avoided. Brains without observations are certainly of no avail at all; and observations, however numerous and however widely distributed, will not at this stage of meteorological science exonerate us from the use of highly trained intelligence.

If trained intelligence is to be devoted to the important questions which fall within the scope of meteorology, there must be money to pay for it at the rates which prevail in the professions with which meteorology must in practice compete.

The Society: Its Relation to the General Meteorological Organisation.

What, then, is the relation of the society to such a future? If I may venture to define it, I would say that the society, as representing all the many-sided interests of meteorological study, may fairly claim the right and duty of fostering, or even of creating, the atmosphere which is necessary for the successful development which is now required.

One of the urgent questions for the future is a new home for its meetings and for its invaluable library. Its journal has enriched the literature of the science with contributions of many different kinds. That, again, is capable of development with great advantage, and in one respect the need for development is extremely urgent. Meteorology is a co-operative science in the progress of which all nations share. Its literature, all told, is probably larger and more diversified in character than that of other sciences. When we take into account the diversity of language and of form, I suppose that there is no meteorologist who can follow for himself without the aid of many colleagues the progress of the science in different parts of the world; and that makes it all the more necessary for the fellows of the society to come to the assistance of each other by providing an effective survey and summary of the work that is being done.

If meteorology is to be put upon a proper footing to discharge its multifarious duties to the public, due provision must be made for the collection of observations to give a proper survey of the rainfall and other aspects of weather for all public purposes.

The Future Responsibility for the Public Memory.

So far there is very little difference of opinion, but when we take the next step and inquire with whom should rest the duty of supplying the necessary observations, the unanimity may be less marked. We are all agreed that it is a matter of national importance, and the necessary cost should be borne by national funds. Now national funds are of two kinds, some derived from Imperial taxation and others from local taxation. In either case the money comes ultimately out of the same pockets, and to me it appears clear that the proper division of responsibility in this case is that the local authorities should contribute the necessary local observations, while the central authority should provide for the organisation of the observations, the co-ordination of the results, and the distribution of the information. Such an arrangement is at the same time the most economical and the most efficient. If the nation wants to know what the weather has been doing at Magna-Parva, it seems natural that it should apply to the local authority of Magna-Parva for the information, because the events of which a record is required occurred within the jurisdiction of the local authority. That the events should be allowed to pass unrecorded, because somebody has not been sent from somewhere else to record them, approaches the limit of absurdity.

A full weather-station of the Meteorological Office now includes a barograph, a thermograph, and a hygrograph. The instruments are easily procured, and, except in an atmosphere like that of London, they are very durable. But such instruments are scientific only if scrupulous attention is paid to setting, checking, and timing—duties which require even more skill and care than the daily readings of standard instruments. A new survey of the meteorology of the country on the basis of self-recording instruments is not unworthy of your attention. They require for their interpretation the accompaniment of the nephoscope and the camera. And, in passing, let me say that the camera obscura which Capt. Cave introduced at South Farnborough seems to me to have possibilities as an instrument of meteorological observation which are in many ways unrivalled.

Other Opportunities of Co-operation.

But observing and experimenting are only one side of meteorological activity, and dealing with observations that have been made requires quite as much scientific skill and daring as devising and making the original observations. From the recollections of my correspondence at the Meteorological Office, I feel sure that there are a considerable number of people with scientific aspirations in this country who regard the Meteorological Office as a collection of leisured clerks waiting to be moved to do something by the fortunate originators of bright ideas who flourish most outside, but, so to speak, within striking distance of, Government institutions. I do not think I do some of my correspondents injustice if I say that the gist of the correspondence is that if they supply the ideas in the way of the design for an instrument or some

original observations in the crude form the Office can do the rest. I can assure them that I have never known the staff of the Office to be at a standstill for lack of ideas to carry out, and from the freedom of this chair I will be bold enough to say that there are worse services to meteorology than helping to carry out the ideas of the Meteorological Office.

The Fellow as a Centre of Local Influence.

And outside the immediate sphere of the society there is much that is necessary to create an atmosphere favourable for the development of the science. We want people to know that meteorology is not exclusively forecasting. No doubt the view into the unknown future is, as Prof. Schuster said in his address to the British Association in 1915, the lure of scientific research, but the long way that has to be travelled in order to make sure of it rewards us with many side-views of common human interest. The discovery of the separation of the atmosphere into troposphere and stratosphere surely belongs to the great achievements of the human intellect, and the meteorological exploration of the globe is worth reciting. So I picture to myself a meteorologist, even in a part of the kingdom or the Empire so remote that he cannot share the privileges of our monthly meetings, who would be a centre of knowledge of the weather without aspiring to a reputation for foretelling the fortunes of his neighbour's hay or anticipating the prospects of a smooth passage.

RECENT IRON-ORE DEVELOPMENTS IN THE UNITED KINGDOM.[1]

WHILST the basis of the prosperity of a country is admittedly agriculture, its industrial growth is founded on mineral resources, and its participation in the world's markets is chiefly dependent on the extent to which these raw materials can be applied to home manufactures.

It is true that the first historical reference to this country mentions the export of tin from Cornwall, and that Great Britain's production and export of copper in the early part of the nineteenth century were the largest in the world; but for its modern industrial pre-eminence it is indebted to its coal and ironstone.

The cheap manufacture of iron and steel in this country has in the past been greatly aided by the providential dispensation that the ironstone was so closely associated in Nature with the fuel required to smelt it that the factor of transportation was practically eliminated.

But the gradual exhaustion of the richer blackbands and clay-ironstones of the Carboniferous formation, and the introduction of the acid Bessemer process of steel manufacture, which requires a pure ore free from phosphorus and sulphur, made it necessary to find other sources of iron-ore supply. For many years the United Kingdom has been dependent for 30 per cent. of the iron-ore used in its blast furnaces on foreign countries. Foreign ore plays even a bigger *rôle* than at first sight appears, since it contains 50 per cent. of iron as against an average of 30 per cent. for home ores. The importation of hæmatite, rich in iron and low in phosphorus, from Spain and the Mediterranean has built up the big iron industries that are engaged in the manufacture of steel by the acid process in South Wales, on the North-West Coast, on the North-East Coast, and in Scotland, where the ports of Cardiff, Port Talbot, Whitehaven, Barrow, Middlesbrough, Newcastle, and the Clyde, situated in close proximity to an ample supply of labour, enable foreign ore and native coal to be easily assembled and cheaply handled.

But it was found to have its drawbacks when the war broke out; and the scarcity of ship-tonnage, which resulted from the activity of the enemy submarines, raised the cost of imported ore from about 20*s.* (at which best Bilbao ore ruled in British ports in 1914) to an actual price of more than 6*l.* per ton, although (under the cloak of Government subsidies) it figured at a lower level. At one period of the war the supply from these sources threatened to be cut off altogether.

To meet this situation an increased development of the Jurassic ironstones of this country was decided on. These ironstones, although abundant and cheaply worked, are what the ironmasters term "lean"—that is to say, they are low in iron, averaging only 28 per cent. of that metal. Moreover, they have a high phosphorus- and sulphur-content, and for the most part are rather siliceous.

The increased production of the domestic phosphoric ores brought about by the war raised many difficult problems. In the first place, it necessitated a different metallurgical treatment. This involved the substitution of basic-lined steel furnaces for those of the acid type, with consequent increased supplies of suitable refractory materials. It also involved large additional supplies of fuel for smelting, and of limestone for fluxing the ore in the blast-furnaces.

Especial difficulties arose with regard to magnesite and magnesite bricks. Prior to the outbreak of the war the magnesite-brick industry was almost wholly in the hands of the Austrians. Possessing in their own country extensive deposits of magnesite peculiarly suited for brick-making, they devoted both skill and money to the perfecting of their products, with the result that before the war they commanded practically the entire custom of the steel trade of this country. To make up for the loss of the Austrian material, arrangements were made by the Ministry of Munitions for the manufacture in this country of magnesite bricks, and the raw material was obtained from Eubœa, in Greece, and from Salem, in Madras.

To furnish the required dolomite and limestone, new quarries were opened up in this country.

With regard to labour a fresh supply had to be found, not only to work the new quarries of ironstone, limestone, dolomite, etc., but also to build the railways required to open them up, to erect extensions to existing plant, to man the new works, to reline furnaces, etc., and this in face of the incessant and urgent calls of the Army to fill the gaps in the fighting line.

Considerable use was made of prisoner labour. The difficulty with prisoners was to induce them to work. On account of the Army regulations, work could be compelled neither by force nor by a reduction of rations. The difficulty was overcome by the introduction of piece-rates, but only to a limited extent, as there was no outlet for surplus earnings in the canteens, food supplies having been cut down on account of the general food shortage. On the average, the efficiency of prisoner labour was about 50 per cent. of that of British labour.

The shortage of quarrymen led to active steps being taken in responsible quarters to supplement and to increase the efficiency of the manual labour at the quarries by the provision of mechanical appliances for stripping, breaking, and loading the ironstone.

In these open workings the output per man employed varies with the thickness of the ironstone-bed, the amount of cover to be removed, the use made of mechanical appliances, and the condition of the weather. The weather materially affects the output, especially where hand-labour is concerned. From

[1] Abstract of a lecture delivered at the Royal School of Mines on May 27 by Dr. F. H. Hatch.

returns made to the Ministry of Munitions in December, 1917, it appears that the average output in the Midlands per man employed was 5 tons per shift, and that it ranged from 3·8 tons where hand-labour was alone employed to more than 15 tons where mechanical excavators were in use under favourable conditions. The actual saving of manual labour which resulted from the installation of mechanical plant in the ironstone quarries during the war is estimated to have been equivalent to more than 3000 men.

The Jurassic ironstones have a wide distribution both in this country and on the Continent. In 1913 Germany mined in Lorraine and Luxemburg 28,000,000 tons of minette ores of Jurassic age out of a total production of 36,000,000 tons of iron-ore, while she imported in addition 3,800,000 tons of the same ore from Briey. Without the Lorraine iron-ore basin, which she stole from France in 1871, Germany would have been unable to go to war, and she took care to secure the remaining portion of the field (*i.e.* the Longwy and Briey basins) soon after the commencement of hostilities. One of the best guarantees for future peace is the provision in the Peace Treaty that no portion of this iron-ore field remains in German hands.

In England the Jurassic formation stretches as a broad band from the coast of Yorkshire to that of Dorset. The ironstones occur on four different horizons, as shown in the following table, which also gives the proportion in which they were worked (in relation to the total production of the United Kingdom) in 1917, and their average iron-content.

Table showing Relative Production and Iron-content of the Jurassic Ironstones.

Ironstone	Ratio to total production. Per cent.	Average iron content (as mined). Per cent.
Inferior Oolite (Northamptonshire and Rutland) ...	21	32
Middle Lias (Cleveland) ...	32	28
Middle Lias (South Lincolnshire, Leicestershire, and Oxfordshire)	9	25
Middle Lias (Raasay) ...	0·5	23
Lower Lias (North Lincolnshire)	18	23
	80·5	27·6

The Jurassic ironstones accounted in 1917 for more than 80 per cent. of the total output of iron-ore in the United Kingdom, the remaining 20 per cent. being made up of hæmatite mined in Cumberland and Lancashire (10½ per cent.), blackband and clay-ironstone mined in the English and Scottish coalfields (8 per cent.), and sundry ores mined in Wales, Forest of Dean, Devonshire, Weardale, and Ireland (1½ per cent.).

The Jurassic ironstones, although poor in iron, are valuable because of their considerable thickness and widespread occurrence at only a slight depth below the surface. With the exception of the Cleveland district of Yorkshire, where the ironstone is now mined underground, the workings are almost everywhere at the surface, the ironstone being quarried after stripping off an overburden of soil, sand, or clay, as the case may be. Since the angle of the dip is usually small—or, in other words, the beds are practically horizontal—considerable areas can be worked before the overburden becomes too great for removal at a reasonable cost. As much as 60 ft. of soft material (sand or clay) can be removed, and, under favourable conditions, probably 100 ft. will be removed.

The different beds of ironstone vary considerably in thickness. The thickest is the Frodingham bed in North Lincolnshire. This ironstone is 25 ft. to 30 ft. in thickness, and consequently can be worked very cheaply by mechanical excavation. Before the war the cost of the stone in wagons at the quarries (exclusive of royalty) was not more than 1*s.* per ton. Probably it is double that now.

As compared with 1916 figures, the production of the Jurassic ironstones as a whole was increased by 45,000 tons per week, equivalent to 2⅓ million tons per annum. The increase reached this maximum in the first half of the year 1918. But it was not possible to maintain production at that figure on account of the calls of the Army on labour. The increase was made mainly in Northamptonshire, Rutlandshire, and Leicestershire, the quarries in these counties accounting for 59 per cent. of the total increase; but Cleveland accounted for 26 per cent. and Oxfordshire for 9 per cent.

With regard to the non-Jurassic iron-ores of this country, the most important are the hæmatite deposits of Cumberland and Lancashire. These ores are remarkable for their richness in iron and their freedom from both phosphorus and sulphur, and therefore furnish a pig-iron very suitable for the acid Bessemer process, and yield an exceptionally pure steel. They are, consequently, in great demand, and this demand was emphasised during the war by the difficulty at one time experienced in securing sufficient supplies of hæmatite ore from Spain. Every effort was therefore made to push production to the utmost, and many abandoned mines were reopened in order to extract the pillars.

The deposits occur in masses of irregular shape in the Carboniferous Limestone, a formation which in this district rests unconformably on the old Skiddaw Slates, and is itself concealed in places by overlying Coal Measures and Red Sandstones or by Boulder Clay. The existing mines are situated between Lamplugh, in Cumberland, and Ulverston, in Lancashire, a distance from north to south of thirty-five miles.

No doubt, besides the known deposits, many undiscovered ore-bodies exist in the Carboniferous Limestone that can be found only by systematic prospecting by boring. Already before the war borings through the Red Sandstones had disclosed, south of Egremont, some of the largest ore-bodies that have been found in either county, with the possible exception of that worked by the Hodbarrow mine. The Beckermet, Ullcoats, and Ullbank Companies are now engaged in developing and working these deposits.

Since the Carboniferous Limestone is of widespread occurrence in the United Kingdom, it might have been expected that valuable hæmatite deposits would have been discovered in other parts of the country. With the exception, however, of deposits of limited extent in South Wales and in the Forest of Dean, this has not proved to be the case.

In the industrial recuperation of this country, now that the war is over, the working of the low-grade Jurassic deposits, which it is fortunate in possessing, is destined to play a great part. This has been rendered possible by the great extensions to iron and steel works that have been initiated with Government assistance during the war. These works have been planned on the most modern lines, and possess on the same site by-product coke-ovens, blast-furnaces, steelworks, and rolling mills. They are designed for the basic process of steel-making, and will be fed with home ores. In choosing the sites for these works regard has been paid to the situation of the raw materials—ore, fuel, and flux—required to supply them. On the completion of these extensions there

should be no necessity for this country to import a single ton of foreign steel. Before the war something like 2,500,000 tons of steel, in the form of slabs, blooms, and billets, were imported into this country annually, mainly from Germany.

But for success in this great undertaking cheap ore and fuel are essential, and these can be obtained, in face of the greatly augmented cost of labour and material, which is a legacy of the war, only by an all-round increase in efficiency, embracing capital, engineering, and labour—capital by the installation of up-to-date equipment, engineering by improved mining methods, and labour by an increased output per man per shift.

These are the pressing problems of the immediate future.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The following appointments have been made:—At King's College: Mr. J. E. Barnard, lecturer in microscopy; Major J. Quinton, lecturer in mathematics; and Dr. W. Wilson, as whole-time senior lecturer in the department of physics. At Bedford College for Women: Mrs. Orson Wood, demonstrator in the department of physics; Miss Woodman, part-time demonstrator in the department of physiology. The chemical department of the college has been divided into the two departments of (*a*) organic chemistry and (*b*) inorganic and physical chemistry. The following appointments have been made to the staff of the new departments:—Mr. Crompton, head of the department of organic chemistry and director of the laboratories; Dr. Spencer, head of the department of inorganic and physical chemistry; Miss Vanderstichele and Miss Triffitt, demonstrators in the department of organic chemistry; Miss Crewdson, demonstrator in the department of inorganic and physical chemistry. At Goldsmiths' College: Mr. G. T. White, head of the engineering and building department.

The title of assistant professor of physiology has been conferred upon Dr. O. Rosenheim, of King's College.

OXFORD.—Mr. Julian S. Huxley, a scholar of Balliol from 1905 to 1909, and from 1913 to 1916 associate professor of biology in the Rice Institute, Houston, Texas, and Mr. Henry Clay, scholar of University College from 1902 to 1906, and author of "Economics for the General Reader," have been elected fellows of New College.

DR. A. W. STEWART, of the University of Glasgow, has been appointed to succeed the late Prof. E. A. Letts in the chair of chemistry in the Queen's University of Belfast.

THE late Sir Archibald D. Dawnay bequeathed for scholarships 5000 1*l*. shares in the firm of Archibald Dawnay and Sons, Ltd., to the Royal Institute of British Architects, 5000 to the London County Council, 1000 to the South Wales Institute of Engineering, Cardiff, and 1000 to the Battersea Grammar School. The bequests will become operative after the death of Lady Dawnay.

APPLICATIONS for the William Julius Mickle fellowship, which is of the value of at least 200*l*., must be made to the academic registrar of the University of London before October 1 next. The fellowship is open to both men and women, and will be awarded to a graduate of the University, resident in London, who has done most to advance medical art or science during the past five years.

APPLICATIONS are invited by the Joint Studentship Committee of the Empire Cotton-growing Committee of the Board of Trade and the British Cotton Industry Research Association for studentships from graduates desirous of continuing their studies on the living plant. The studentships are of the yearly value of about 150*l*., and applications must reach the secretary of the British Cotton Industry Research Association, 108 Deansgate, Manchester, on or before August 27.

THE prospectus of university courses in the Municipal College of Technology, Manchester, for the session 1919–20 has now been published. The college offers systematic training in the principles of mechanical, electrical, municipal, and sanitary engineering; of architecture and the building trades; of the chemical industries and the textile industries; and of photography and the printing crafts. It possesses extensive laboratories and workshops equipped with full-sized modern machinery, tools, and apparatus, including not only machines of the types now in general use, but also machines especially constructed for demonstration, experiment, and original research. There is a generous provision of both entrance and post-graduate scholarships. Courses of post-graduate and specialised study and research are offered for a fourth year to students who have successfully completed the three years' course for a degree in the Faculty of Technology in the Victoria University of Manchester conducted in the college, or are otherwise deemed competent to enter upon them.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 21.—M. Léon Guignard in the chair.—J. **Boussinesq**: The existence of an approximate relation, pointed out by M. Carvallo for quartz, between the two rotatory and dispersive powers of bodies.—A. **Gautier** and P. **Clausmann**: The action of fluorides upon vegetation. Field culture experiments. The fluorine in these experiments was added in the form of amorphous calcium fluoride; it was found to be favourable to the growth of wheat, oats, carrot, broad bean, cabbage, pea, poppy, potato, and hemp. No effect was observed with barley, rye, bean, buckwheat, and mustard, whilst beetroot, turnip, and onion were prejudicially affected by fluorides.—P. **Sabatier** and A. **Mailhe**: The catalytic formation of alkyl chlorides, starting with the primary alcohols. A mixture of hydrochloric acid and alcohol vapour, passed over alumina heated to 370° to 450° C., gives the alkyl chloride mixed with the ethylenic hydrocarbon produced by the dehydration of the alcohol. Primary, secondary, and tertiary chlorides may be formed in this reaction.—V. **Grignard** and G. **Rivat**: The addition compounds of halogen acids to diphenylarsenic acid. The addition products $[(C_6H_5)_2.AsO.OH]_2HCl$ and $(C_6H_5)_2.AsO.OH.HCl$ and two corresponding compounds with HBr were isolated and analysed.—G. **Giraud**: The classification of substitutions of certain automorph groups of n variables, and the algebraic relations which exist between any $(n+1)$ functions corresponding with certain of these groups.—M. de **Broglie**: The X-ray spectra of the elements. Measurements of the K spectrum of rhodium and L absorption spectrum of radium.—J. **Hebert-Stevens** and A. **Larigaldie**: Radiotelegraphy by infra-red radiation. The light from an arc projector is filtered through a screen which absorbs all the visible rays but allows a portion of the infra-red rays to pass. The receiver is a parabolic mirror with a sensitive thermo-couple placed at its focus, and the latter actuates a relay. Messages have been sent

over 20 kilometres with this apparatus.—S. **Posternak**: The synthesis of the hexaphosphate of inosite and its identity with the phospho-organic reserve principle of green plants. The ester was prepared from inosite and phosphoric acid in presence of an excess of phosphorus pentoxide. The yield is low, 3 to 5 per cent., and the substance is identical in all respects with the natural product from phytine.—R. **Levaillant** and L. J. **Simon**: The action of chlorosulphonic acid on methyl hydrogen sulphate. Methyl chlorosulphonate, $Cl.SO_2.(O.CH_3)$, can be isolated from the products of this reaction.—P. **Thiéry**: The geology of the region of Alais (Gard).—L. **Gentil**: The genesis of the forms of strata in chalk districts called *rideaux*.—S. **Stefanescu**: The teeth of elephants and mastodons.

CAPE TOWN.

Royal Society of South Africa, June 18.—Dr. J. D. F. Gilchrist, president, in the chair.—Miss Ethel M. **Doidge**: South African Microthyriaceæ. This group of fungi has been recently revised by von Hohnel and Theissen and others, and the characters of the family Microthyriaceæ have been more clearly defined. A short account of the genera represented in South Africa, and descriptions of species in the Cryptogamic section of the Union Mycological Herbarium, Pretoria, are given.—C. L. **Herman**: Note on carbolic acid as a fixative for histological preparations. Carbolic acid in 5 per cent. solution was found a most efficient fixative for histological purposes. It has been used since 1912 for all organs, including the central nervous system. For the thyroid gland it is especially good, as it gives thorough fixation of the colloid without shrinking or distortion. It acts by precipitating the protein without, however, entering into combination with it. It rapidly penetrates all tissues, especially the nervous tissue, and fixes both the cytoplasm and the nucleus without distortion or alteration. The optical differentiation becomes very good, and all cell-structures are found well and clearly defined. Staining is facilitated, and all stains are readily taken up.—J. R. **Sutton**: A contribution to the study of the diamond macle, with a note on the internal structure of diamond. The first part of this paper describes the aspect and characteristics of macles from various South African diamond mines, and gives statistics showing that the standard thickness to which macles tend to conform is almost exactly one-half that of the perfect octahedron standing upon an equal face. The so-called "twinning plane" is not necessarily a true plane at all, but rather an irregular surface. Bultfontein Mine is remarkable for the large number of irregular twins it produces and the small percentage of macles. In the second part the author discusses the "grain" of diamonds, as revealed by broken macles and by broken simple crystals, in which the fracture lies in a dodecahedral plane of symmetry, and deduces therefrom the primary cubical structure. The points of agreement and disagreement with the structure deduced by Bragg (by means of X-ray research) are indicated. Three orders of cleavage are shown, *i.e.* parallel to the faces of the octahedron, cube, and rhombic dodecahedron respectively.

BOOKS RECEIVED.

Strawberry Growing. By Prof. S. W. Fletcher. (The Rural Science Series.) Pp. xxii+325+xxiv. plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) 1.75 dollars.

A Large State Farm: A Business and Educational Undertaking. By Lt.-Col. A. G. Weigall and Castell Wrey. Pp. xiii+82. (London: John Murray, 1919.) 2*s*. 6*d*. net.

The Flower and the Bee: Plant Life and Pollination. By J. H. Lovell. Pp. xvii+286. (London: Constable and Co., Ltd., 1919.) 10*s*. 6*d*. net.

Utility Ducks and Geese: Their Successful Management for Egg and Meat Production, with Brief Notes on Some Ornamental Waterfowl. By J. W. Hurst. Pp. 93. (London: Constable and Co., Ltd., 1919.) 2*s*. 6*d*. net.

The Farmer and the New Day. By K. L. Butterfield. Pp. ix+311. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) 8*s*. 6*d*. net.

The Fauna of British India, including Ceylon and Burma. Coleoptera, Chrysomelidæ (Hispinæ and Cassidinæ). By Prof. S. Maulik. Pp. xi+439. (London: Taylor and Francis, 1919.)

The Cactaceæ: Descriptions and Illustrations of Plants of the Cactus Family. By N. L. Britton and J. N. Rose. Vol. i. (Publication No. 248.) Pp. vii+236+xxxvi. plates. (Washington: The Carnegie Institution, 1919.)

The Iron and Steel Industry of the United Kingdom under War Conditions: A Record of the Work of the Iron and Steel Production Department of the Ministry of Munitions. By Dr. F. H. Hatch. Pp. xii+167. (London: Privately printed for Sir John Hunter by Harrison and Sons, 1919.)

The North Riding of Yorkshire. By Capt. W. J. Weston. Pp. viii+161. (Cambridge: At the University Press, 1919.) 2*s*. 6*d*. net.

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THURSDAY, AUGUST 21, 1919.

NAVIGATION AND NAUTICAL ASTRONOMY.

(1) *Air Navigation. Notes and Examples.* By Instructor Capt. S. F. Card. Pp. vi+140. (London: Edward Arnold, 1919.) Price 10*s.* 6*d.* net.

(2) *Navigation.* By Prof. Harold Jacoby. Second edition. With a chapter on Compass Adjusting and a Collection of Miscellaneous Examples. Pp. xi+350. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 11*s.* 6*d.* net.

(1) THE author of this much-needed little book may be regarded as something of a pioneer, for, despite the general interest taken in the subject, this would appear to be the first work formally devoted to the navigation of the air. When, some years since, schools of navigation were established at various centres of aviation, Capt. Card was associated with Brig.-Gen. Briggs, R.A.F., in framing a general plan for the education of pilots and observers. This fact alone is a sufficient proof of the competence of the author for the work he has taken in hand.

Nautical readers will be interested to see how closely the navigation of the air is related to the coastal navigation with which they are familiar. We have the same problems, but on a greatly magnified scale. Thus in fixing a position by cross-bearings, it is not a matter of a couple of headlands three or four miles apart, but Reading and Oxford, or Bedford and Cambridge, are proposed as pairs of bearings suitable for the exercise of the student.

As stated in the preface, the subject is treated in a very elementary manner, making little demand upon the mathematical knowledge of the student. The explanations are clear and simple, with an abundance of well-executed diagrams. An excellent notion adopted is to add at the end of each chapter a blank page for the reception of any notes the student may wish to make upon the contents of the chapter.

Upon the subject of the navigation of the air Major-Gen. Seely, Under-Secretary for Air, made an important statement in the House of Commons on June 26. He said that the whole system of instruction is being revised, and the schools re-organised, and that endeavours are being made to perfect, so far as possible, mechanical aids, such as the sextant. He added that there is great hope that a satisfactory form of artificial horizon for air use will be brought out, and experiments are in actual progress. Gen. Seely's remarks appear to refer chiefly to that form of navigation over the open ocean with respect to which there is at present much uncertainty and obscurity. Capt. Card's manual, on the other hand, is limited to the type of navigation over the land corresponding with what is known as "pilotage" in ordinary marine navigation, in which position is generally determined by sextant angles and bearings of known objects. Let us hope, when more data are available, that the author may supplement his very clear exposition of this type by a more general treatise, embracing also ocean air navigation, in which position has to be determined by observations of the heavenly bodies. Some knowledge has been gained from the experiences of Grieve and Brown, but much remains to be learnt in these matters.

(2) Prof. Jacoby in his book is somewhat hampered by self-imposed limitations. Navigation and nautical astronomy, being mathematical sciences, can scarcely be completely treated upon a non-mathematical basis, whereas in this instance we have it explicitly stated in the preface that "the author has not assumed that the reader possesses formal mathematical and astronomical knowledge, or desires to possess such knowledge."

Nevertheless, upon the lines so laid down we have a very readable book, calculated to be of interest not only to those unconnected with the sea who would acquire some insight into the processes of navigation, presented in a chatty, discursive, or, as the author himself puts it, "informal," manner, but also to the professional navigator, who, having already some acquaintance with the matters dealt with, may like to see the various problems treated in a somewhat different fashion from that to which he is accustomed. In a little work of 350 pages, about one-half of which is devoted to tabular matter, we have an account of the leading modern methods employed in position finding at sea, while the various tables, though in somewhat abridged form, suffice for the calculations of actual navigation in ordinary circumstances. Amongst these the Davis table of combined natural and logarithmic haversines, which so greatly simplifies the calculations for the Marcq position lines, is conspicuous. Another useful feature is Table ii., an azimuth table, but with regard to this a word of caution might perhaps be added that, based as it is on the formula,

$$\frac{\text{sine azimuth}}{\text{sine hour angle}} = \frac{\text{sine polar distance}}{\text{sine zenith distance}}$$

the slow rate of change in the sine about 90° takes us into troubled waters in the neighbourhood of the prime vertical, where some other method for azimuth might be employed with advantage.

One other observation may be offered, with regard to a statement on p. 99 that "the moon is now so rarely observed that we have not given examples of lunar observations." It is quite true that tables of distances are no longer published, and that the method of finding longitude by measuring lunar distances has in consequence become obsolete. But for position line work an altitude of the moon in the daylight, with a simultaneous observation of the sun, often enables the navigator to obtain a complete "fix" at one and the same time, an advantage unattainable by any other method in the daytime. Probably more alti-

tudes of the moon are observed at sea to-day than at any time previously.

There is one class of reader to whom the work of Prof. Jacoby should especially commend itself, and that is the fortunate owner of the palatial steam yacht who would fain make himself acquainted with what it is that his sailing master is about. It was perhaps in the interest of this type of reader that a final chapter is devoted to a circumstantial account of the voyage of the hypothetical steam yacht *Nav* from New York to Colon on December 18, 1917. Moreover, the story is very well told. H. B. G.

BEVERAGES.

Beverages and their Adulteration. Origin, Composition, Manufacture, Natural, Artificial, Fermented, Distilled, Alkaloidal, and Fruit Juices. By Dr. Harvey W. Wiley. Pp. xv+421+11 plates. (London: J. and A. Churchill, 1919.) Price 21*s.* net.

DR. WILEY remarks that his book "is not written for the scientific investigator, but for the average, sober-minded, reasonably well-educated American citizen." A general account of the beverages discussed is, in fact, what is given, neither severely technical nor flimsily "popular." The facts are stated carefully, as would be expected from the author, but little or no scientific knowledge on the part of the reader is assumed.

Water, as the beverage *par excellence,* is given pride of place. Both ordinary drinking supplies and mineral waters are dealt with, and the information given is such as will enable the reader to obtain an intelligent idea of water supply in its bearing upon the public health and upon manufacturing operations. Various processes of water purification are briefly described, and the utility of chemical and bacteriological analyses of water is explained. Touching on the widespread faith of ordinary humanity in the virtues of medicinal springs, the author dryly remarks that this faith is "not so well founded in fact as it is extensive in belief." At the same time, he indicates the factors producing the undoubted benefits which often result from "taking the waters"—namely, the change of habits, the simpler diet, avoidance of excesses, and so on. These, of course, are active aids in restoring health even when the water itself has no particular therapeutic value, except, perhaps, as a laxative.

Apropos of the habit of drinking ice-cold beverages—a habit more common on the other side of the Atlantic than here—the evil effects are summed up in an amusing quotation:—

> Full many a man, both young and old,
> Has gone to his sarcophagus
> By pouring water, icy cold,
> A-down his hot œsophagus.

"Soft drinks" have an especial interest for Americans just now, and perhaps they may presently acquire an added importance for ourselves. The term is applied in the United States to "non-alcoholic" beverages. Whilst the typical "soft drink" is soda-water mixed with a flavoured syrup, other "soft" beverages are legion. Apart from the undesirability of much sugar in drinks consumed largely by children, and the above-mentioned habit of taking them ice-cold in hot weather, Dr. Wiley does not see much objection to the general run of non-alcoholic beverages when these are prepared in a hygienic manner from wholesome materials. Some, however, contain drugs such as caffeine or cocaine; these are highly objectionable, and should, the author considers, be prohibited by law.

In the sections devoted to tea, coffee, and cocoa the reader will find some notes and historical sketches that are worth perusing, apart from the main descriptions of these beverages.

An interesting section is the one dealing with wine. Dr. Wiley has personally inspected nearly all the French vineyards where the most famous wines are produced, and has also visited the Spanish, German, and other wine-growing areas in Europe. His pages will be welcomed as giving a present-day account of the industry. He remarks, by the way, that the mean annual wine-production of the Château Y'quem is only 90 tuns, and opines that there is something miraculous in this quantity supplying the large amount of Château Y'quem wine, so-called, that is drunk in the world.

Some sensible advice is offered on the production of uniform and distinctive types of wine in the United States, and on the adoption of distinctive native names for them, instead of calling them by foreign names which are not really applicable.

Whilst here and there one misses the facile touch of the purely literary man, Dr. Wiley's occasional notes and historical extracts serve agreeably to enliven the substantial body of facts which he has brought together. The book is, of course, written from the American point of view, but much of the matter is of quite general interest, and will appeal to readers on both sides of the Atlantic. C. SIMMONDS.

OUR BOOKSHELF.

Les Symbiotes. By Prof. Paul Portier. Pp. xx+315. (Paris: Masson et Cie, 1918.) Price 5 francs.

THIS book, dedicated to his Serene Highness the Prince of Monaco, contains a lively exposition of a heresy, in regard to which the author frankly admits that if some years ago he had seen it stated at the beginning of an essay, he would probably have read no more. The heresy is that, apart from bacteria, all organisms are double, being formed by the association and "emboîtement" of two different kinds of creature. There are partners within every cell, partner-bacteria, which the author calls "symbiotes." A symbiote is a domesticated micro-organism with two remarkable properties, an extreme plasticity that

enables it to adapt itself to the most diverse conditions, and a strong capacity for synthesis. These symbiotic bacteria come in with the food from the extra-organismal environment, and, though the partnership they form is usually indissoluble, they may in certain circumstances rejoin their wild relatives and live an independent life.

Every naturalist knows that lichens are double organisms, due to the symbiosis of algoid and fungoid partners, which form a very effective unity. Prof. Portier maintains that all organisms except bacteria have in a similar fashion a dual nature. A theory somewhat like this was propounded by Mereschowsky in 1910. But if all cells are thus dual, why, one hastens to ask, have not the ubiquitous, symbiotic, intra-cellular bacteria been seen before? The answer is that they have been often seen, but persistently misinterpreted. They are the components of the mitochondrial apparatus, those minute formed bodies, with many an alias, which have been described in the cytoplasm of all sorts of cells. It is true that these mitochondria have often been credited, with more or less probability, with a definite functional *rôle* in the metabolism of the cell, a *rôle* differing from cell to cell; but are not the symbiotes very plastic? Prof. Portier is good-humoured enough to quote the paradox that a theory is not of value unless it can be demonstrated false. We have no hesitation in prophesying that his theory will attain that value—which is just what he would have said himself a few years ago. We are bound to admit that the author is a downright good sportsman.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

The Magnetic Storm of August 11–12, 1919.

One of the very great magnetic storms, the most violent recorded at this observatory since that of September 25, 1909, commenced quite suddenly at 6.50 G.M.T. on August 11 from a very slightly agitated normal curve in both the elements of declination and horizontal force. The H magnet increased sharply by 84γ ($1\gamma \equiv 10^{-5}$ C.G.S. unit), and the D magnet swung 10′ to the west. The direction of motion in each element was immediately reversed, with a very rapid decrease of 113γ in H, and a swing in D, equally rapid, to the east of 16′. After a few very rapid swings the spot of light due to H decreasing went off the recording drum at 7 a.m., and remained off until it returned at 7.24 G.M.T. At 8.12 G.M.T. H increased rapidly, the range of the swing exceeding 446γ. At 8.50 G.M.T. it again decreased rapidly, the spot of light remaining off the recording drum until 9.43 G.M.T. These oscillations in H were accompanied by rapid swings in D. After its sudden increase and decrease at the beginning of the storm it swung 60′ to the west. At 8.52 G.M.T. it was 50′ in the opposite direction. The extreme range in D during the storm was 110′, and of H, since the spot of light travelled off the drum on either side, greater than 780γ.

The greatest phase of the storm was between the hours 14 and 20 G.M.T. on August 11. The spot of light with increasing H was twice off the drum, from 15.36 to 16.10 and from 16.20 to 16.38 G.M.T. At 20 G.M.T. the oscillations of H were less rapid, but they recommenced, after a comparative lull, at 0.50 G.M.T. on August 12. At 1.38 G.M.T. a fine peak of decreasing H began, which was followed by a peak of increasing H at 3.15 G.M.T., the total range being 404γ. Corresponding with this movement D showed a very fine peak of swing to the west, with a range of 66′, at 1.48 G.M.T. These oscillations in both elements, particularly at the beginning and at the maximum phase of the storm, were extremely rapid.

These rapid oscillations were succeeded for a period of about five hours by a violent shivering of relatively small amplitude, but of great rapidity, in both H and D. This phenomenon of so marked a type I cannot recall to have seen in former storms. After this, at 8.30 G.M.T., August 12, the swings became slower and smaller in amplitude on the whole, until the storm died quite abruptly in H, and less marked, though abrupt, in D, at 19 G.M.T. on August 12.

The *Times* for August 12 announced that the Minister of the Interior in Spain had notified the Press of a breakdown in telegraphic and telephonic communication on the preceding day. The postal authorities in this district were also inconvenienced on the same day by earth currents. Needless to add that the solar surface has been greatly disturbed by sun-spots lately.

I looked out for a possible display of aurora on the night of August 11, but the brightness of the moon effectually veiled any such appearance, even if it were present. The cirrus clouds, however, were arranged in streaks, seemingly radiating from the north-west. I have noticed such an arrangement of the cirrus clouds in former magnetic storms.

A. L. Cortie, S.J.

Stonyhurst College Observatory, August 14.

Wild Birds and Distasteful Insect Larvæ.

I have read the letter of the Hon. H. Onslow (Nature, August 14, p. 464) with much interest, and I shall certainly continue the investigation as soon as opportunity offers.

I regret that I must disagree with the attitude adopted by Mr. Edward R. Speyer (Nature, August 7, p. 445). In my letter on the subject I had no intention of refuting the observations of Prof. Poulton or of any other observer. I simply recorded what I had seen, and suggested that parasitism of the larvæ might afford an explanation, but Mr. Speyer introduces a condition which certainly did not exist in the spring of 1918. He writes:—"In times of stress birds have long been known to subsist upon insects with highly distasteful qualities"; and again: "The currant-moth larva . . . has merely been eaten by the thrush, and possibly by the other birds mentioned . . . when the stress of having to feed a family has made such a practice a necessity."

At the time my observations were made there was no necessity for the birds to feed upon these larvæ. Insect larvæ of all kinds were seldom, if ever, more numerous. There were an abundant supply and a great variety. The currant-moth larvæ were probably the most numerous, and with such an ample supply of food the birds fed upon them.

Walter E. Collinge.

The University, St. Andrews.

NOTES ON STELLAR CLASSIFICATION.

IN NATURE, December 23, 1915, and in the third Bulletin of the Hill Observatory, I referred to the shape of the temperature curve which I had published in connection with the meteoritic hypothesis, and I pointed out that if we could deal with a large number of stars, a generalised temperature curve might be placed before us by considering the number of stars in the various groups, for the reason that the longer a star remained at about the same temperature, the larger would be the number of stars in that group, while a rapid rise of temperature would reduce the number. I gave the curves thus produced by discussion of the stars included in the catalogue of the 470 brighter stars published in 1902, and in the later catalogue of the 354 less bright stars catalogued at the Hill Observatory.

In order to carry the inquiry one step further, I now reproduce these two curves, together with a third (Curve 3) based on the catalogue of 287 stars, the result of still more recent work at the Hill Observatory.

One of my chief objects in plotting this third curve was to see whether its shape agreed with the two former ones, because the more the curves based on different catalogues agree, the more they may be accepted as a basis for consideration.

It will be seen that the third curve follows suit with the first and second. Kinks occur in practically the same positions both on the ascending and descending arms of the curve. The main difference is that the apex of the curve occurs later in the case of the hotter stars than it does in either of the others; but the remarkable verticality of the curve near the middle of the ascending side is common to all, and, indeed, is one of the most striking features.

If the similarity of the three curves obtained from different data may be taken as suggesting a probability that the classification on which they are based does really provide us with homogeneous groups of stars on both sides of the curve, several interesting inquiries are suggested.

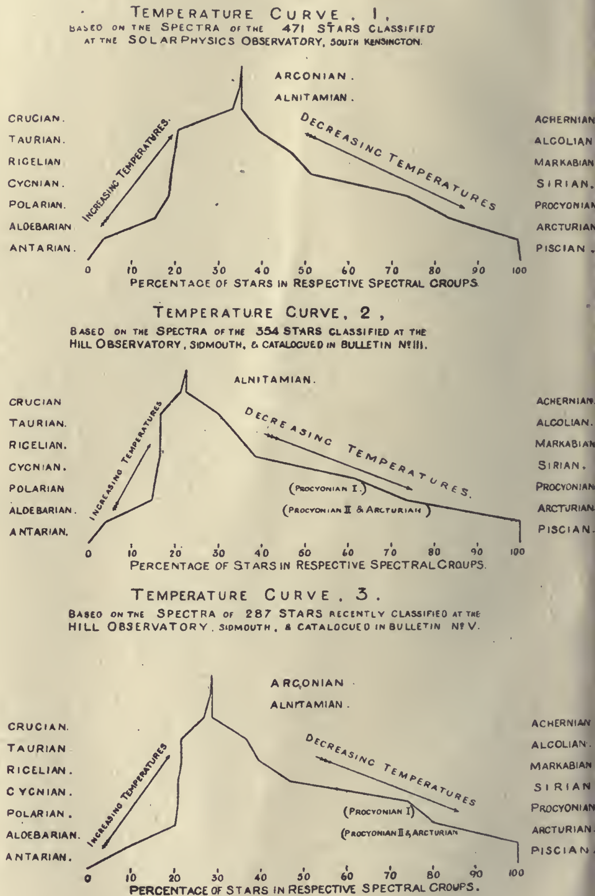

FIG. 1.—Curves based on numbers of stars and temperatures.

Supposing that the stellar systems with which we are dealing were of very recent origin, it is clear, if the meteoritic hypothesis is true, that the stars will all be found in the ascending arm. If, on the contrary, the systems are very old, and there are no recent formations, it is the descending arm into which they will be crowded.

If my classification embracing high and low temperatures really does provide us with homogeneous groups of stars, some hotting, some cooling, and if such a result proceeds from either a simultaneous or a continually acting formation of star groups, a break in the series can only be due to the cause I have already considered in Bulletin IV., a more rapid change of temperature giving an accelerated stellar change at one point of the curve.

But on the supposition that neither a simultaneous nor a continually acting formation took place, then we should expect breaks or a break in the curve. Supposing one break, we should be dealing with two groups of stars representing the old and the newer formations, or let us say old and new star systems. If this be conceded, the classification lands us in a new region of thought which it is important to study, and the vertical part of the curve may be taken as indicating the locus of the cessation of the old system and the advanced guard of the new.

PLATE I.—COMPARISON OF THE TWO CLASSIFICATIONS.

BULLETIN III.—CATALOGUE OF 354 STARS.

Argonian										
Alnitamian		B	O*e*5							
		2	1							
Crucian		B3	B2	B1	B5					
		7	6	1	1					
Achernian		B3	B2	B5	B*p*	B3*p*	B5*p*	B8	K	
		11	4	4	3	1	1	1	1	
Taurian										
Algolian		B8	B5	A						
		7	6	2						
Rigelian		B9								
		1								
Markabian		A	A*p*	B8*p*	B9					
		12	1	1	2					
Cygnian		A	A2	A2*p*						
		1	1	1						
Sirian	I.	A	A2	A3	A*p*	A2*p*	A4			
		24	20	8	3	1	1			
	II.	A5	A	A2	A3	A8	F	F5		
		12	2	3	2	1	3	1		
Polarian		F8*p*	G							
		2	1							
Procyonian	I.	F	F5	F*p*	F8	G	A	A5	A8	
		15	14	1	2	1	1	5	1	
	II.	G	G*p*	G5	F	F5	F8	K5*p*	K	A8*p*
		13	2	6	2	1	2	1	6	1
Aldebarian	II.	K	G	K5*p*	K*p*	F				
		10	2	1	1	1				
	I.	K	K5	K2	K*p*	M*a*				
		12	5	1	1	4				
Arcturian		K	K*p*	K5	G2	G5	B5			
		42	1	2	2	11	1			
Antarian		M*a*	M*b*	K5						
		10	3	1						
Piscian										

BULLETIN V.—CATALOGUE OF 287 STARS.

Argonian		O*d*						
		1						
Alnitamian		B2	B	O*e*5				
		2	1	1				
Crucian		B	B1	B2	B3	B5		
		1	2	2	9	1		
Achernian		A	B2	B2*p*	B3	B5		
		2	2	1	14	4		
Taurian								
Algolian		B5	B8	B9				
		2	5	1				
Rigelian		B9						
		2						
Markabian		A	A*p*	A2	B5	B8	B9	
		9	2	1	1	5	2	
Cygnian								
Sirian	I.	A	A*p*	A2	A3	A5	B8	B9
		25	1	12	3	9	2	1
	II.	A	A2	A3	A3*p*	A5	F	G*p*
		7	2	1	1	8	6	1
Polarian		F						
		2						
Procyonian	I.	F	F5	F8	F8*p*	A	A5	
		7	5	3	1	1	1	
	II.	F	F8	G	G5	K		
		2	1	4	5	4		
Aldebarian	II.	K	K*p*	K5	G2	G5	M*b*	
		11	1	2	1	1	1	
	I.	K	K5	K5*p*				
		7	7	1				
Arcturian		K	G2	G5	F			
		29	2	9	1			
Antarian		M*a*	M*b*	K5				
		17	5	3				
Piscian								

On my classification we shall be able to study the peculiarities and differences of the two systems; and a valuable test is in this way provided.

These considerations are certainly fundamental enough, and there are others.

The similarity of the third curve to the first and second justifies the return to some considerations which I referred to in the fourth Bulletin regarding the kinks in the curves. The descending arm of the curve is much more continuous than the ascending one; the greatest change from the more vertical to the flatter shape of the ascending arm occurs at the Aldebarian and Crucian stages—that is to say, the greatest number of stars at nearly the same temperature occurs in those two regions. It is suggested that this is due to the fact that the stars involved reach their highest temperature in these regions, so that we may assume that not all stars first visible as Antarian reach the highest temperature, but one set may reach it near the Aldebarian stage, and another at the Crucian stage, or rather *between* the Crucian and Alnitamian stages, only a very small number of stars reaching the Argonian stage. It is very remarkable what a small percentage of stars reach the Argonian stage. It is fair to assume that the power of reaching these various stages of temperature must depend on the initial equipment of the swarm, and from this point of view a close inquiry into the mass and density conditions may be expected to help matters.

In all that has gone before I have dealt with a rise followed by a fall of temperature. I am bound to say that for years after I put this view forward as the only one acceptable on the meteoritic hypothesis it was generally scouted. This would not have mattered so much had the Harvard classification, with its thousands upon thousands of stars, not taken the other view of a continued fall of temperature, as demanded by the views formulated by Kant and Laplace.

There have been many signs lately that the opposition to my views is weakening; but the more they are accepted, the more is it necessary that a large number of stars should be added to those I have classified. We want tens of thousands of stars in homogeneous groups in order that inquiries may be prosecuted with advantage.

I showed in Fig. 1 of the fourth Bulletin that the letters A, B, F; K of the Harvard classification occurred in the spectra of stars located on both sides of my temperature curve, and although differences were indicated by sub-numbers, it is a common practice to use the descriptive letters alone, and it is difficult, therefore, to ensure homogeneity.

One of the great desiderata of the moment, therefore, is to inquire whether something cannot be done to render the stupendous and long-continued work of classification carried out at Harvard available under conditions which would ensure the complete homogeneity of the stars classed together. In order to study this question I have prepared tables which show the Harvard classification of the stars included in the Hill Observatory catalogues of 354 and 287 stars (PLATE 1). I chose these catalogues because the classification was carried on by the same three observers and with the same instrument, and the classification by each observer was carefully checked by the others. The dispersion employed between K and H_β, 927 Ångström units, is equal to 28 mm.

My hope was that the same sub-numbers of the Harvard classification would not be found on both sides of the temperature curve.

In the comparisons I have previously made of the Harvard classification and my own I have indicated the Harvard classification of the stars chosen as the type star in each of my groups, but it will be seen from the present comparison that the Harvard classification, in consequence of the much greater detail which it attempts to secure, does not justify us, as I hoped it would, in giving a distinction between the letters and their accompanying numerals used on both sides of the curve.

But this difficulty is not common to all parts of the curve. Near the top, at the Crucian and Achernian stages, the greatest number of stars in which, on both sides, are classified B3, it is not of the highest importance to draw the distinction. In the case of the Sirian and Cygnian stars, where it is imperative that a complete separation should be chosen, the majority of stars in both are classified in A, with the exception of two classified as F, which probably may be due to misprints. But when we come to the difference between the Polarian and Procyonian and the Aldebarian and Arcturian, it will be seen that the attempt is hopeless. Twenty-two Aldebarian stars are classified as K, and forty-two Arcturian stars also classified as K. NORMAN LOCKYER.

Hill Observatory,
August 21, 1919.

THE SUPPLY OF DRUGS DURING THE WAR.

WHEN war broke out, the National Health Insurance Commission was charged by the Government with the duty of safeguarding the position of this country with regard to the supply of drugs, and the Commissioners have just issued a memorandum [1] describing the work done in this connection. The work fell mainly into two categories, viz. (1) conservation of existing supplies by such means as restriction of exports and the most economical use of the materials available, and (2) encouragement of home production of fine chemicals used in medicine. The second is, of course, much the more interesting, and some of the results of this work were illustrated in the exhibits shown by various fine chemical manufactureres at the recent British Scientific Products Exhibition. Certain manufacturers took up on their own initiative the pro-

[1] Memorandum on the Special Measures Taken by the National Health Insurance Commission (England) in Relation to the Supply of Drugs and her Medical Stores during the War. Cd. 183. (1919.)

duction of such drugs as salvarsan, aspirin, and salicylic acid, and in these cases the Commission assisted by securing the release of controlled raw materials.

The report alludes to the help rendered by the Royal Society, under whose auspices the manufacture of a number of drugs was undertaken in about forty university and other laboratories. It is satisfactory to learn that the knowledge so acquired of the best methods of manufacture has not been wasted, but has been placed at the disposal of manufacturers. As a result the Commissioners are able to report that some sixteen medicinal chemicals, in which Germany had a virtual monopoly before the war, are now being made in this country, in some cases on a scale large enough to provide a margin for export.

On the whole, though difficulties arose from time to time, the needs of the Army and the nation appear to have been met adequately so far as all essential drugs are concerned.

In view of this it seems clear that of the hundreds of synthetic drugs which used to be imported from Germany before the war many were unnecessary additions to our therapeutical resources. It is, in fact, an interesting exercise to look through such a publication as Arend's "Arznei-Mittel," or one of the "Guides" and "Mentors" to therapeutics, which used to be distributed by the German drug manufacturers, and see how many of the products, each with its carefully plausible name duly registered, have passed out of use and almost out of memory.

The Commissioners point out that the manufacture of fine chemicals developed in this country during the war will need to be watched carefully, suitable encouragement being given, where necessary, and means provided for keeping manufacturers in touch with scientific workers. These functions they consider might well form part of the duties of the Ministry of Health.

While it is important that the manufacture of synthetic drugs should be assisted in every possible way, it is no less important that the old-established British fine chemical industry in the manufacture of alkaloids should not be neglected. In this connection it should not be forgotten that the supply of some of the raw materials, such as cinchona bark and opium, required by this branch of the industry is now in urgent need of attention from an Imperial point of view.

ERNST HAECKEL.

AFTER a prolonged illness Prof. Haeckel died at his house in Jena on August 8 at the age of eighty-five. His signature of the infamous manifesto issued by ninety-three German professors in 1914, his recent bitterness towards Britain, and his acquiescence in Germany's crimes need not blind us to what is lasting in the work he did, to features of greatness in his character, and to the irresistible charm of his personality. He was a champion of evolutionism from the publication of the "Origin of Species" onwards, in days when the doctrine was unpopular and upholding it meant obloquy; he broke new zoological ground in many directions, and he was the teacher of many illustrious naturalists.

Ernst Heinrich Haeckel was born at Potsdam on February 16, 1834, and went to school at Merseburg; he studied medicine at Würzburg, Berlin, and Vienna; he was much influenced by the writings of Schleiden, one of the founders of the cell theory; by Johannes Müller and Virchow among his teachers; and by his friend and fellow-worker, Gegenbaur. After a short period of medical practice he became lecturer in the University of Jena and full professor of zoology in 1865. In spite of repeated and tempting offers, he remained in this position until his retirement from active duties a few years ago. He found opportunity, however, for many journeys, from an early pilgrimage to Down in 1866 to later explorations in Ceylon and further east. He wrote three interesting volumes of travel, and indulged his love of sketching in a large series of landscapes. In his early youth he had dreams of becoming a painter, and his artistic skill is familiar to those who know his monographs on Radiolarians, Sponges, Siphonophora, and Jellyfishes. Indeed, his facility became almost a snare, for he was sometimes guilty, they say, of improving upon Nature and allowing art to mingle with his science. The symmetry which is exhibited in his well-known genealogical trees, which are often referred to contemptuously, as if it was not a legitimate zoological ambition to discover and describe relationships, was an expression of the same artistic sense, which the rugged facts of Nature do not often gratify.

Haeckel was a popular teacher, and students from many parts came to listen to his lectures and to work in his laboratory. He lectured rapidly and picturesquely, with infectious enthusiasm, and the beautiful diagrams and blackboard drawings added to the vividness of the impression. While he was always very busy with work of his own, especially perhaps during the *Challenger* period, he took a keen interest in those students who showed anything of his own temper, helping those who helped themselves. At his best he was a very handsome man, with overflowing kindliness, with no end of energy, with a passionate love of the beautiful whether in the microscopic Protists or in mountain scenery. His bible was Goethe.

In addition to his technical systematic work and his championing of Darwinism and freedom of thought and speech, what services did Haeckel render? By his vivid style he made biology popular and diffused concepts of development and evolution throughout the world, for the sale of books like "The Natural History of Creation" was colossal. His "Generelle Morphologie" (1866), as a generalising survey, occupies a place beside Spencer's "Principles of Biology," and, like it, is held in considerable esteem by the few who have read it. He led the way in applying evolution ideas to zoology in general, as in his

adoption of Fritz Müller's law of recapitulation—that individual development (ontogeny) tends to be a condensed epitome of racial evolution (phylogeny); and although this generalisation requires very careful handling, and has often led to abuse in the writings of undisciplined popularisers, few would go the length of saying that its recognition has not enriched zoology. In his studies of Monera and the like Haeckel did not a little to show the fundamental biological importance of the Protozoa; his gastræa theory had a considerable and, on the whole, useful influence on embryology, though it has now been superseded; he was an explorer of the rarely visited field of pro-morphology (the study of shape and symmetry), in which the pioneers of bio-physics are now finding treasure. We might recall many of his suggestions which subsequent research has justified or may still justify: he was very early on the track of phagocytosis; he was sure that crystals have much to tell the biologist; he felt that heredity and memory were in some way related phenomena, and that the unconscious-psychical was not a contradiction in terms; he insisted that we have not heard the last of the application of the second law of thermodynamics to organisms; he was one of the early voices crying in the wilderness that biology was an integral part of education.

Anti-metaphysical by profession, Haeckel nevertheless expressed in his theory of cell-souls and the subjective aspect of the movements of matter a poetical hylozoism, akin to that of the early Ionic philosophers. He has been likened in this respect to a re-incarnation of Xenophanes. It was characteristic of his buoyant optimism that he never seems to have suspected how naïve his monistic philosophy was; but those who deplore the mischievousness for the ignorant of such a book as "The Riddle of the Universe" ought to take their share of the blame for not providing for the people equally readable antidotes or prophylactics. The rancour he displayed in these tragic years towards a country where he had many friends and in which he had been highly honoured must be viewed in the light of the fact that he was an octogenarian in enfeebled health when the war broke out, yet in his attitude and his utterances we see the continuation of that aggressiveness and bitterness which marked his attacks on conventional Christianity. It is in general terms a difficult riddle which his fellow-countryman Ostwald had the frankness to express in 1914: "Dieser unversöhnliche Gegner alles dogmatischen Christentums erwies sich als der beste und vorgeschrittendenste 'Christ' den Ich je persönlich kennen gelernt hatte." The explanation may be in part this, that Haeckel had several moods almost equally dominant. He was scientific, doubtless, and he himself declared that he was all for science, yet he had not that resoluteness of precision which Huxley referred to when he said that the assertion that outstrips the evidence is not only an error, but also a crime. He had the artistic and romantic temperament, he was a worshipper of beauty, he was to an extraordinary degree a passionate man of feeling. But he was also a preacher, a reformer, a propagandist—hence his surprising sympathy with Luther. He was so convinced in his own mind that he had got hold of the truth, and that those who differed from him were following errors and superstitions, that he was incapable of calmly considering criticism, still less of changing his views. His enthusiasm for science and his passion for Nature showed themselves in another expression in something like fanatic intolerance in his propagandist writings. Yet Haeckel did a day's work and a man's work in a fine, vigorous way, always himself and no other, and if he overdid the hunt for superstitions, who shall say that there was no excuse? Many people are not so good as their creeds, but everyone who knew Haeckel in his prime will agree that he was much better. *Vale.*

NOTES.

A CONFERENCE of representatives of the Meteorological Services of the British Dominions is to be held in London on September 23–27, when the subjects to be considered will include the meteorological arrangements for the exchange of observations by wireless at comparatively long distances; specification of observations for the surface and the upper air with the codes for transmission; the consideration of instruments and material for the investigation of the upper air; the selection of stations of the "Réseau Mondial" for the purpose of the general climatology of the globe (see "Réseau Mondial," 1911–12–13, M.O. Publications 207g, 209g, and 214g); the provision of current meteorological information for the main air routes of the world; co-operation in the investigation of the meteorological conditions of aerial navigation; and the trade routes and the meteorological survey of the oceans by observations transmitted by radio-telegraphy from ships. The following official meteorologists of the Dominions beyond the seas are expected to be present:—Capt. A. J. Bamford (Director of the Meteorological Service of Ceylon), the Rev. D. C. Bates (Director of the Meteorological Office of New Zealand), Mr. H. A. Hunt (Director of the Weather Bureau of the Commonwealth of Australia, Melbourne), Mr. H. Knox Shaw (Director of the Meteorological Service of the Public Works Ministry, Egypt), Mr. C. Stewart (Chief Meteorologist of the Union of South Africa), Sir Frederick Stupart (Director of the Meteorological Service of Canada), and Dr. G. T. Walker (Director-General of Indian Observatories).

IN connection with the autumn meeting of the Iron and Steel Institute, which is to be held at the Institution of Civil Engineers, Great George Street, Westminster, on September 18 and 19, there is to be, on the first-named date, a general conference on fuel economy, at which the following communications will be read:—Report on "Fuel Economy in Steel Works," Dr. W. A. Bone, Sir Robert Hadfield, Bart., and A. Hutchinson; Report on "Fuel Economy in Foundry Practice," H. J. Yates; and "Fuel Economy in German Iron and Steel Works," Cosmo Johns and L. Ennis. Papers down for reading and discussion on September 19 are:—"Synthetic Cast-Iron," C. A. Keller; "The Fluxing Action of Iron Oxides on Acid-Furnace Structures," J. H. Whiteley and A. F. Hallimond; "The Woody Structure of the Fractures of Transverse Test

Pieces from Special Steels," J. J. Cohade; "Nickel-chrome Forgings," J. H. Andrew, J. N. Greenwood, and G. W. Green; "Brittleness in Nickel-chrome and other Steels," F. Rogers; "Temper Brittleness of Nickel-chrome Steel," R. H. Greaves; "Experiments with Nickel Steels," N. Hudson; and "The Cause of Irreversibility in Nickel Steels," K. Honda and H. Takagi. Other papers expected are:—"Decarburisation of Steel," E. D. Campbell; "Nature of the A_1 Transformation and a Theory of Quenching," K. Honda; and "The Structure of Iron-Carbon-Chromium Alloys," T. Murakami.

Prof. G. E. Hale, director of the Mount Wilson Observatory, has been elected a foreign associate of the Paris Academy of Sciences.

The appointment of Lord Lee of Fareham to the Presidency of the Board of Agriculture and Fisheries, in succession to Lord Ernle, resigned, has been approved by the King, as has also that of Sir Eric Geddes as Minister of Transport.

The Bessemer medal of the Iron and Steel Institute for the present year has been awarded to Prof. F. Giolitti, of Turin.

The Fream memorial prize for 1919 has been awarded by the Board of Agriculture and Fisheries to Miss Doris Anderson, a student of University College, Reading.

The Elgar scholarship in naval architecture of the Institution of Naval Architects has been awarded to Mr. W. G. Green, and the Earl of Durham prize to Mr. W. G. Perring, both of Chatham Dockyard.

It is announced that the widow of Prof. Milne has decided to return to her native country, Japan, and that in consequence the house at Shide, Newport, Isle of Wight, in which Prof. Milne did such important work in seismology is to be sold shortly by public auction.

The death is announced of Prof. William Smith Greenfield, who held the joint chair of pathology and clinical medicine in the University of Edinburgh from 1881 to 1912. He was, in addition, physician to the Royal Infirmary, Edinburgh, and was probably the last occupant of such a dual professorship, which was not infrequent in a former generation before the present era of specialisation. Prof. Greenfield was a student of University College, London, and a graduate of the University of London, and previous to his appointment to the Edinburgh chair had been assistant physician and lecturer on pathological anatomy at St. Thomas's Hospital and professor-superintendent of the Brown Institution. His chief contributions to pathology were on anthrax and allied diseases, renal diseases, pyæmia, and diseases of the thyroid gland.

The Government has decided to institute a competition for commercial types of aircraft with the view of obtaining a type giving greater safety. Prizes will be offered for three types of aircraft—a smaller aeroplane, a larger aeroplane, and a seaplane respectively. The terms of the competition will be announced shortly.

The Home Office Committee on Miners' Lamps gives notice that it is open to consider new suggestions for improving the safety or illuminating power of safety lamps, and to examine and, if necessary, test any new devices or new types of lamps that may be sent by inventors. Communications on the matter should be addressed to Mr. E. Fudge, secretary of the Committee, Home Office, Whitehall, S.W.1.

The United States Ordnance Department is appointing a number of experts in mathematics and dynamics to conduct scientific research on ordnance problems, to act as advisers on mathematical and scientific problems for the Department, and to maintain connection between the Department and the scientific world.

Dr. Ph. Vogel, the well-known Indian archæologist, has published at Leyden an interesting paper entitled "The Sign of the Spread Hand, or Five-finger Token, in Pali Literature." He quotes numerous examples from the sacred books of Buddhism to show that this familiar symbol, a protection against the Evil Eye and the influence of malignant spirits, was commonly used in ancient India in connection with animal sacrifice and tree-worship. In one remarkable case the tree is a *Ficus indica*, and the spirit by which it is haunted is propitiated by means of a human sacrifice, the entrails being used as garlands and palm-marks made with the blood. This explains why women in the case of suttee up to recent times, when going to cremation with their lords, used to make marks on the gates of the palace with their hands steeped in vermilion. Numerous examples are given to prove that the use of this symbol as a protection is common in modern India and in other parts of the world.

In the *Museum Journal* (vol. ix., Nos. 2–3) for September–December, 1918, Mr. C. W. Bishop discusses the horses of Tang T'ai-Tsung and the antecedents of the Chinese horse. In considering this series of reliefs in the University Museum, Philadelphia, a question arises about the origin of the representation of the flying gallop, showing the horse with legs extended skimming through the air as if shot from a bow. There was one culture area in which the representations of both animals and men in motion were executed with a vigour and a force unknown elsewhere—the Minoan or Ægean. All study points to the extreme unlikelihood of an independent invention of the same artistic convention in the Mediterranean and in China. The problem is by what means the idea was transmitted. The writer concludes that it spread in pre-Classical times to the regions north of the Black Sea, where it was eventually carried both to Sassanian Persia and to ancient China, apparently through the medium of the so-called Scythian culture, which overspread to much of Eastern Europe and Central Asia in early times, and in many ways acted as a sort of connecting link between East and West.

The first number of a new periodical, the *Journal of Industrial Hygiene* (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.), has reached us. It has grown out of the recent establishment, at Harvard University, of teaching and research in this field, and is published mainly under the auspices of this organisation, although it aims at being international in character. The scope of the journal may be gathered from the titles of the articles in the present issue. "Industrial Medicine and Surgery," "Lead Poisoning," "Fatigue," and "Telephone Operating in its Medical Aspects," together with full abstracts of current literature bearing on cognate subjects, are included. The printing and illustrations are well done. Although the formation of so many new journals for special departments of knowledge is in general to be regretted, there is no doubt that this one will be found of much value in bringing the results of scientific research to the acquaintance of the industrial world. The publication of results of original work, however, except such as is directed to very special economic ends, in journals of limited range is apt to lead to their becoming lost to the general body of scientific doctrine.

DURING the war the proper provision of life-belts and other life-saving appliances on ships became of vital importance owing to the submarine menace. One of the most widely used appliances was a life-jacket stuffed with "kapok" or floss. This floss has very great buoyancy, a jacket containing 24 oz. of the fibre being capable of supporting an adult in the water. According to the existing official regulations, the only kapok that may be used for this purpose is Java kapok, which consists of the long hair surrounding the seeds of a tree which occurs abundantly in the Dutch East Indies. A similar material is, however, obtainable from India, but from a different tree, and this Indian floss cannot under the existing regulations be used for life-jackets. The results of trials made at the Imperial Institute, details of which are given in the current issue of the Bulletin of the institute, have shown that the Indian floss can fully satisfy all the requirements as regards buoyancy and freedom from water-logging. It is, therefore, suggested that the use of Indian kapok should be officially permitted for life-jackets. Inquiries made by the Imperial Institute showed that kapok, equal in quality to that used in the trials, is available in India in large quantities.

THERE seemed a prospect but a little while ago of seeing a live okapi in London, for it was known that the Zoological Society had made a generous offer for a young animal which had for nearly three years been the pet of Mme. Landaghem, the wife of a Belgian medical officer stationed several hundred miles above Boma, on the Congo. This, however, was not to be, for Mme. Landaghem has patriotically presented her pet to her native country. It has just arrived in Antwerp, the first of its kind ever seen in Europe. The existence of this remarkable animal was first brought to light, it may be remembered, by Sir Harry Johnston, and through his good offices the first skin and skeleton to reach Europe were those of the female which arrived in London in 1901. Previous to this he had demonstrated the existence in the Belgian Congo of a large mammal new to science by sending to the Zoological Society of London a bandolier cut from the remarkably striped hindquarters of one of these elusive creatures—elusive because, though the natives had long talked mysteriously of some strange animal living in the innermost recesses of the forest, and had constantly promised to produce a specimen, that promise was overlong in its fulfilment. This bandolier Dr. P. L. Sclater—then secretary to the Zoological Society—concluded had been cut from some species of zebra hitherto unknown, and accordingly bestowed upon it the name *Equus johnstoni*. This seemed warranted by the evidence, but the sequel showed that it was to the giraffes, and not to the horses, that this bizarre-looking animal was related. As yet the sex of the new arrival has not been stated, but if it should prove to be a male the development of its horns will be watched with interest by all zoologists.

WE learn from the *Revue Scientifique* that the courses of higher instruction at the Institut d'Optique will be attended each year by selected military and naval officers in addition to university students and others associated with the optical industry. On the industrial side, the full course covering the working of glass and fine mechanics will extend over three years. Subsidies have been promised from the French Government to meet the annual expenditure, but an appeal is made for donations towards the initial expenses of the establishment of the institute. The list of members of the council of the institute includes a number of distinguished physicists.

DR. ARTHUR HOLMES (Quart. Journ. Geol. Soc., London, vol. xliv., p. 31, 1919), in a paper in which field-observation and delicate laboratory studies are happily combined, describes the pre-Cambrian and associated rocks of Mozambique. He utilises radioactivity as a means of correlating the ancient rocks with those of other areas; the ratio of lead to uranium present assigns the granulitic granites of Mozambique to the Middle pre-Cambrian, and the gneissose granite to a lower series, probably corresponding with the intrusive "Laurentian" rocks of Canada. The composite origin of the biotite-gneisses is shown, not only by the field-evidence of assimilation of schists by a granitic magma, but also by a radium-content intermediate between that of granites and schists. The lines of "inselberge" in the country are well discussed, and are connected with axes along which the uprising magmas have elongated themselves in the direction of the strike. Though we hesitate to use the phrase "the new geology," Dr. Holmes is an exponent of the most recent developments in an old science, which his papers help to keep very much alive.

MESSRS. POSNJAK and Merwin (*Amer. Journ. Sci.*, vol. xlvii., p. 311, 1919) provide a critical review of the natural hydrated ferric oxides, stress being laid on the curves that represent the phenomena of experimental dehydration. Turgite, which we should now write as turiite, is the only exception to the rule that decomposition takes place in the middle portion of the curve, accompanied by a colour-change from yellow to red. Turiite shows a gradual loss of water, and is, therefore, not regarded as a definite chemical compound, but as a solid solution of hæmatite and göthite with adsorbed water. The authors conclude from the close agreement of the molecular ratio of Fe_2O_3 and H_2O in specimens bearing different mineral names that there is no *series* of hydrates of ferric oxide in Nature, but that the only existing mineral ferric hydrate is "ferric oxide monohydrate," crystallising polymorphically as göthite and lepidocrocite. Limonite is an "amorphous" condition of the same substance. The fibrous structure that is so common in specimens styled "limonite" indicates some form of crystallisation, and the authors regard the fibrous examples, not as true limonite, but as göthite which has adsorbed capillary water. Both göthite and lepidocrocite are rhombic, the latter having a slightly lower density, and occurring in red, scaly crystals. The authors are able to add some new points to the mineralogical description of this species.

THE question of the degree of roundness of grains of various minerals occurring in sands is interestingly dealt with by Mr. J. J. Galloway ("Rounding of Sand Grains by Solution," *Amer. Journ. Sci.*, vol. xlvii., p. 270, 1919). The author urges that even quartz becomes appreciably rounded in natural waters by solution, and he illustrates experimentally how the smaller grains of a powdered mineral lose their forms and become spheroidal far more quickly than the larger ones. Rapid solution produces grain-surfaces as smooth as glass, while slow solution, of which quartz serves as an example, gives dull surfaces like those due to strong abrasion. Mr. Galloway does not assert that the cause of rounding can be determined in any given case. He shows, however, that we must consider solution as a factor.

PROF. P. G. H. BOSWELL summarises his recent work on sands, including the graphic representation of their texture, in a very convenient form by the publication of his inaugural lecture on "Sands: considered Geologically and Industrially, under War Conditions" (University Press of Liverpool, 1919, price 1s.).

UNDER the heading of "The Freedom of the Skies" the *Scientific American* for July 26 has an article by Prof. McAdie which deals with "some of the problems that will have to be solved as the human race takes to the air." Much that is said is reasoned from the analogy of the "freedom of the seas." The recent great war has fully shown the value of a command of the sea or air. The word "overcloud" is proposed for association and definition with "oversea" and "overland." It is suggested that what the Gulf Stream and the Japan Current are to the mariner the prevailing westerlies are to the aviator. The trades and monsoons are likened to rivers at the ground surface. It is stated that "the war just ended exemplified for the first time in history the right of a neutral nation to claim as territory the air above." The author deals with many features of interest, and the article contains much that is suggestive; one such point is that "if a steamship meets an adverse tide, her progress is delayed just so much, depending on the strength of the current; whereas when an airship encounters strong head winds, her pilot can rise or fall below the level of that particular air current and find a level in which the air will be moving with him and not against him." Many of the analogies dealt with show the great advantage of the combined association of mathematics and meteorology for a proper study of the upper air.

MONTHLY meteorological charts, which are issued by the Meteorological Office both for the North Atlantic and East Indian seas, are primarily intended for seamen. Now that aircraft are becoming of such importance, especially considering the rapid strides made in the last few months and the prospective voyage to India of R 33, these meteorological charts are assuming much greater interest. The Atlantic chart for the present month contains a large amount of valuable information. At present the North Atlantic is the ocean of primary importance for aircraft, but the winds are dealt with in a less satisfactory manner than for other oceans, "the frequency, the direction, and the average force of some characteristic winds are shown," whilst fuller details and *greater precision* are essential. A track is given showing the mean path of centres of cyclonic areas between America and Europe in August for the years 1883–91. A longer period, embracing the storms of recent years, would enhance the value of this information, appending, if practicable, details of individual instances. In August the south-east trade is seen to extend considerably to the northward of the equator, reaching on the eastern side so far north as latitude 13° N. The frequency of cloud with various winds at different times of day is given for Valencia and for St. Johns, Newfoundland, at the back of the chart. The August chart for the East Indian seas shows that the south-west monsoon is predominant over the sea to the north of the equator, whilst south of the equator to 25° S. the south-east trade blows almost uninterruptedly. North-westerly winds predominate over the whole length of the Red Sea. In August the average barometric pressure in the Red Sea is lower than in any month of the year, and the average air temperature is the highest of the twelve monthly values.

IN the Journal of the Royal Society of Arts for June 20 Mr. Watson Smith directs attention to a theory recently advanced by Tschirch to account for the spontaneous combustion of haystacks. It is based upon observations made in the drying of medicinal plants. A first phase of heating is regarded as due to oxidation processes caused by the plant oxydases at the expense of the air present in the stack. This results in a small rise of temperature, which ceases when the oxygen of the air in the stack is exhausted. In the next phase the chief *rôle* is played by reductases, which act energetically between 50° and 70° C., deoxidising and eventually carbonising such substances as amino-acids and carbohydrates. The danger of ignition lies in the accumulation of oxygen withdrawn by the reductases; the actual reduction processes would not themselves produce sufficient heat to ignite the material. To obviate the risk of spontaneous combustion two precautions are recommended:—(1) A thorough drying of the hay before stacking, which minimises enzyme action, and (2) thorough aeration of the stacks, which may be secured by building them in layers with air spaces between.

THE forty-third annual report of his Majesty's Inspectors of Explosives (1918) (Cd. 278, 1919) is of particular interest by reason of the inclusion of approximate figures for the production of explosives and ammunition of all classes in this country for the whole period from the outbreak of war to the signing of the armistice, together with statistics of the accidents which occurred. Of the three chief classes of military explosives the outputs and casualties were:—(1) Ballistites and cordites, 181,712 tons; persons killed, 35; injured, 50 (of the killed 27 lost their lives in one accident). (2) Picric acid, T.N.T., and other coal-tar products, 107,713 tons; killed, 177; injured, 368. (3) Other nitro-compounds, 62,048 tons; killed, 31; injured, 91. In all there were 1277 accidents reported, and in 544 no personal injury was caused. The maximum number of persons employed was 86,555; the average, 61,808. The total loss of life was 325, with 1316 injured, giving 1·25 killed per 1000 and 5 injured, compared with a fatality rate of 1 per 1000 for the five-year period ending 1910. The inspectors are more than justified in their comment that, "having regard to the output produced at high pressure, largely by workers with no previous experience, supervised in many cases by equally inexperienced officials, the general result may be regarded as satisfactory." It is a remarkable testimony to the supervision and protection of the workers that in filling more than 8,374,000,000 small-arm cartridges and 83,600,000 hand grenades in licensed factories during the war period there was not a single fatal accident and only 48 workers injured, with one exception all being engaged on cartridges. Nor was there any loss of life in the manufacture of blasting explosives (other than gunpowder) or in the conveyance of explosives during the year 1918. The report lays special stress on the dangers of compositions containing aluminium powder, for, although such mixtures are not unduly sensitive during test, accidents have been somewhat frequent, the reason of the primary ignition being obscure

WHEN a photographic negative is treated with a solution of a chromate well acidified with hydrochloric acid, the silver of the image is converted into silver chloride, and subsequent application of a developer reduces the silver chloride and leaves the metallic silver much as it was. But if the acid is deficient in quantity, reduction products of the chromate remain and reinforce the image. This method of intensification is well known. In the *British Journal of Photography* for August 8 Messrs. Lumière and Seyewetz state that they find that the acidified chromate may be replaced by a solution of potassium chlorochromate, thus using a definite substance instead of an indefinite or adjustable mixture. They find, too, that if the process is repeated on the same negative, the effect gradually diminishes, and after five or six treatments the intensification becomes

negligible. They suggest that the chlorochromate acts thus:—

$$KClCrO_3 + 2Ag = KAgSO_3 + AgCl,$$

and that as only the silver chloride is reduced by the developer, the amount of silver available for the process is halved by each application of it. They have not, however, yet proved that the double sulphite is produced and that it resists the developer, and they are carrying their investigations further in this direction.

DURING the last few years the use of electric heating appliances has become common in the laboratory and workshop owing to the production of trustworthy heating elements. In most of these an alloy, capable of resisting oxidation at 1100° C., is wound round a tube or muffle, in the interior of which a temperature of 1000° C. can be attained. The small electric furnaces exhibited by Messrs. A. Gallenkamp and Co., Ltd., at the recent British Scientific Products Exhibition of the British Science Guild illustrated the numerous purposes for which such articles may be used with advantage, and were of satisfactory design. For heating small articles, or for estimating the amount of carbon in steel by combustion, the heating chamber consists of a silica tube 1–2 in. in diameter and 12–20 in. long, the power required to maintain a temperature of 1000° C. ranging from 400 to 800 watts. For laboratories in which many estimations of carbon in steel have to be made daily, two- or four-tube furnaces are constructed to facilitate rapid working. A special type, wound in sections capable of separate heating, is provided for organic combustions. For incinerations, the hardening of small steel articles such as taps, dies and gauges, etc., the muffle type of furnace is used, the dimensions of the largest made being 14×7×5 in., consuming 2300 watts. Messrs. Gallenkamp's furnaces are designed so that a new heating element can easily be inserted by the user, thus avoiding delay in the case of a winding burning out. Special attention is also paid to efficient lagging, and the casing and supports are strong and durable. Resistances for controlling the temperature are supplied with each furnace. A further commendable feature is that a purchaser may procure a furnace to suit his own work, and is not compelled to take one of the ordinary stock patterns.

THE following new books of science are announced:—By *Messrs. George Allen and Unwin, Ltd.*—"Mineral Resources of Georgia and Caucasia," D. Ghambashidze; "The Equipment of the Workers," "The Education of the Workers," and "The Environment of the Workers." By *Mr. Edward Arnold*—"Ions, Electrons, and Ionising Rays," Dr. J. A. Crowther; "Surveying," W. N. Thomas; "Tacheometer Tables," Prof. H. Louis and G. W. Gaunt; "The Principles of Electrical Engineering and their Application," Prof. Gisbert Kapp, vol. ii.; "Examples in Electrical Engineering," J. S. Gill and F. J. Teago; and "Algebra for Engineering Students," S. Eastwood and J. R. Fielden. By *Messrs. W. Heffer and Sons, Ltd. (Cambridge)*—"Groundwork of Surgery for First-year Students," A. Cooke. By *Messrs. Crosby Lockwood and Son*—"Electric Spark Ignition in Internal Combustion Engines," J. D. Morgan; and new editions of the "Mechanical Engineer's Pocket-Book," the late D. Kinnear Clark, revised and enlarged by H. H. P. Powles; and "Hand Sketching for Mining Students," G. A. Lodge and N. Harwood. By *Messrs. Methuen and Co., Ltd.*—"Coal Mining and the Coal Miner," H. F. Bulman. By *Messrs. Seeley, Service, and Co., Ltd.*—"Chemistry and its Mysteries: The Story of what Things are made of, Told in Simple Language," C. R. Gibson, and "The Marvels of Photography: Describing its Discovery and Many of its Achievements," C. R. Gibson. By *Messrs. Witherby and Co.*—"A Geographical Bibliography of British Ornithology," H. Kirke Swann, W. H. Mullens, and F. C. R. Jourdain; "A Handbook to the Vertebrate Fauna of North Wales," H. E. Forrest; "Meteorology for All," D. W. Horner; "The Birds of France," C. Ingram; and "Monograph of the Pheasants," W. Beebe, vol. ii.

OUR ASTRONOMICAL COLUMN.

KOPFF'S COMET 1906 IV. = 1919*a*.—M. Ebell has published (*Ast. Nach.*, 4996) an ephemeris of this comet from Dr. Zappa's elements (*A.N.*, Bd. 194) with a correction of +23·48′ to the mean anomaly. The observations made during the month show a correction to this of about −7′ in declination. The following positions (for Greenwich midnight) include this correction:—

	R.A. h. m. s.	S. Decl. ° ′	Log r	Log Δ
Aug. 21 ...	19 29 22	8 16·4		
23 ...	19 30 16	8 13·6	0·250	9·942
25 ...	19 31 19	8 11·2		
27 ...	19 32 28	8 9·1		
29 ...	19 33 45	8 7·3		
31 ..	19 35 8	8 5·8	0·256	9·973

The computed brightness decreases from magnitude 10·9 to 11·1 during this period. The comet passed through perihelion on June 28 last.

OCCULTATION OF SMALL STARS BY JUPITER.—Mr. Arthur Burnet sends particulars of two phenomena of this kind that he predicts will happen in the coming months. The star B.D. +18° 2062, mag. 8·9, R.A. 8h. 46m. 52s., dec. 18° 23′ 22″ N., will be occulted on September 15 between 14h. 15m. and 15h. 1m. G.M.T. As Jupiter will rise at Greenwich at 13h. 30m. on that night, the possibility of successful observation from this part of the world is doubtful. On October 5 the star B.D. +17° 2007, mag. 7·8, will be occulted before 11 o'clock G.M.T., when it will not rise at Greenwich until after midnight. The occultation may be visible in India from 10h. 25m. to 11h. 36m. Apparent place of the star on October 5, R.A. 9h. 1m. 46s., dec. 17° 26′ 2″ N.

A MAGNETIC STORM.—The traces on the sheets of the magnetographs at Greenwich showed violent disturbance on Monday, August 11, beginning about 7 o'clock in the morning and lasting for twenty-four hours. From notes in the daily Press it appears that telegraph lines and cables were affected, and that operators experienced much difficulty due to earth currents. There was a spot on the sun at the time, not of the largest size, but about 500 millionths of the visible surface in area, which had passed the central meridian on August 8. There was also a broken group of small spots following this, and another regular spot rather less in area than the first was approaching the central meridian.

THE RECENT SOLAR ECLIPSE.—Though the observers of the British expedition to the Island of Principe were not favoured with specially fine weather, some useful results were obtained. Ten of the plates exposed were spoiled by cloud so far as the object of the expedition was concerned, but give an excellent representation of the large prominence which was on the sun's limb at the time. The remaining six photographs show κ^1 and κ^2 Tauri and two or three other stars. The measurement of these should show the looked-for deflection if it exists.

INDUSTRIAL FATIGUE.

THE Industrial Fatigue Research Board, which was recently appointed by the Department of Scientific and Industrial Research and the Medical Research Committee jointly, has quickly got into the swing of its labours. It has just issued two brief reports, and announces other more lengthy reports which are in preparation. In Report No. 2 Mrs. Ethel E. Osborne describes "The Output of Women Workers in Relation to Hours of Work in Shell-making." The women were engaged in the operation of "ripping" or "part-off" on 6-in. shells, and their output was compared when they were on twelve-hour and eight-hour shifts. The output of work achieved during each hour of actual work in the shorter shifts was 6·5 per cent. greater than in the longer shifts, but because of the improvement in time-keeping and the more efficient running of the machinery the production per hour of factory work was 15 per cent. greater. Determinations of hourly output showed that during the last hour of the long shifts there was always a low output, whilst on the short shifts output was maintained throughout.

In Report No. 3 Col. C. S. Myers, a member of the Board, describes "A Study of Improved Methods in an Iron Foundry." Hitherto the American methods of time and motion study have gained very little acceptance in this country, and the enterprising managing director of the iron foundry investigated by Col. Myers is greatly to be congratulated on his initiative in applying the methods practically to the production of small iron castings. Although the hours of work were at the same time reduced from fifty-four to forty-eight per week, the men were able to increase their total output greatly, and they suffered less fatigue. The men were on piece rates, but they were paid on the novel, but wholly equitable, principle that the greater their production the greater their scale of pay *per piece*, or the rate of pay rose automatically with increase of total output. In that the overhead charges of a factory are usually almost the same whether the output of a worker be small or great, it is only fair that employers should adopt this system of payment, but it is absolutely exceptional for them to do so.

MEAN SEA-LEVEL.[1]

THE science of oceanography is slowly coming into its own, and it has advanced greatly in the last twenty years; but still, of those who think of it at all, many people know very little what it is. It is looked upon, often enough, as an easy, descriptive science, a small part of a simple, descriptive geography. But if this be true at all, it is a very small part of the truth; for the great problems of oceanography are physical problems, to be approached by mathematical methods, and soon involving us in difficult questions of hydrodynamics, and other difficulties besides. In the elementary task of the exploration of the sea Englishmen have taken a large, perhaps a lion's, share; in one special part of scientific hydrography, the theory of the tides, they have done a great deal, for such names as Lubbock, Whewell, Airy, Kelvin, and George Darwin come at once to our minds. But in other parts of the subject, and in recent times, we have done less; and the Scandinavian countries especially have done a great deal more. Bjerknes, Witting, Otto Pettersson, Sandström, Fridjof Nansen, Helland-Hansen, Madsen, and De la Cour are only a few names of men who, from Denmark to Finland, have studied the hydrographical phenomena of the Baltic or the wider problems of hydrography.

Among its most fundamental problems are those connected with the determination of mean sea-level—if we may so speak of something that has never yet been determined. There is scarcely a physical constant so freely spoken of or so often used; every elevation in the world is referred to it, but no man knows what it is. Two or three generations ago a few observations of consecutive tides were supposed to be enough to ascertain it—a month was ample; but we have long known that the "constant" so determined is no constant at all, but is subject to complicated fluctuations, some regular and some, at first sight, erratic. This first approximation to "mean sea-level" has a very appreciable annual fluctuation, an "annual tide"; it alters from year to year; at any one locality these changes are apparently irregular, but they are found to tally with one another over large areas of coast; there are important differences of sea-level between one station and another; and there are slow changes of long period which again may be found common to large areas. Among the elementary difficulties of the problem is the fact that the annual change of level is much too great for a simple astronomical explanation—it is not a "solar tide"; and, that being excluded, we are thrown back on two hypotheses or sets of hypotheses, the one meteorological, the other based in one way or another upon movements of the earth's crust. A great deal has been written on the subject in recent years; we cannot attempt to review the whole question, but must be content to give an abstract of an important paper lately published by Prof. Rolf Witting, of Helsingfors, director of the Oceanographical Institute in that University.

The "level" of the sea, or, more generally speaking, the form of the surface of the sea, is a resultant of forces both extrinsic and intrinsic; that is to say (after we have eliminated by a sufficient number of observations the effect of the tides), we have to deal with the densities and currents of the sea itself, and with the winds and the atmospheric pressure acting upon its surface. It is plain that where the sea is less dense its surface will tend to stand at a higher level than where it is more so; this is an intrinsic phenomenon. As to the extrinsic forces, inasmuch as the winds are determined by the distribution of atmospheric pressure, the latter may be employed as our common indicator for both factors—that is to say, for the winds and for their effect upon the sea.

For the latter, or extrinsic, forces Prof. Witting gives us the following law or laws:—(1) Every barometric distribution of any permanency produces a deformation of the surface of the sea. (2) The ascending slope so produced is not identical in direction with the barometric gradient, but deviates to its right-hand side, in the northern hemisphere. (3) The amount of slope is greater than that which would correspond with the hydrostatic pressure induced by the barometric distribution. (4) The amount of the deviation, and also the ratio between the amount of slope and the barometric gradient, are (to a first approximation) independent of the gradient, but largely affected by the shape of the basin and by the distribution of densities in its water-layers.

From Fig. 1 we may judge, for a particular date, the relative directions of the barometric gradient and of the sloping surface of the Baltic Sea.

In a celebrated observation (to which, by the way, Prof. Witting does not happen to refer) Sir James Ross found that, at a certain point within the Antarctic Ocean, a change of barometric pressure produced, to all intents and purposes, its precise hydrostatic equiva-

[1] Rolf Witting: "Hafsytan, Geoidytan och Landhöjningen utmed Baltiska Hafvet och vid Nordsjön." Fennia 39, No. 5. (Helsingfors, 1918.)

lent in the level of the sea. But, whatever may have been the exact circumstances and conditions of that experiment, its result is very far from holding good within our narrow seas. According to Prof. Witting, both in the North Sea (on the average) and in the open basin of the Baltic the slope of the sea-surface is equivalent to a column of water about 35 times that of the barometric gradient measured in mercury; whereas, hydrostatically, the ratio should be only about 13·5 times, or in the simple ratio of the specific gravities of mercury and water; in still narrower areas, as in the gateways of the Baltic, the ratio may be much greater, amounting to as much as 100 times. In the open basins the direction of the water-slope deviates from that of the barometric gradient by about 55°; and this value is again exceeded in the narrower channels. In other words, then, we find that in the opener basins the disturbance of the sea-level is nearly three times as great as the direct hydrostatic effect due to atmospheric pressure, which is as

FIG. 1.—Sea-level and pressure-distribution in March, 1906; represented by isanomalies from the means for the whole period 1898–1912. Thick lines, sea-level in half-centimetres; broken lines, barometric pressure in tenth-millimetres.

much as to say that the dynamical effect of the wind must account for well-nigh two-thirds of the total effect produced. Moreover, in these waters the current produced by the wind deviates by about 20° to the right of the direction of the wind itself; and the current thus moves sideways up the slope, about 45° to the right of its uphill direction, which is an oceanographical paradox.

In the gateways of the Baltic these external forces by no means fully explain the phenomena which occur. We may calculate the amount of water which escapes from the Baltic, on an average, month by month; and, proportional to these amounts, we then discover residual deviations of slope in the water-levels. Within its gates the Baltic may be regarded as a basin the levels of which (except for perturbations at the mouths of rivers) are mainly determined by the barometric field. But the gateways themselves constitute a sluice, damming up the waters within; and in this region the height of the dam will depend not only on the atmospheric pressure, but also on the quantity of water which passes over into the North Sea, the level of which varies according to its local conditions and to more distant phenomena in the ocean. In a general way, the peculiarities of the narrow entrances to the Baltic are not difficult to comprehend.

But let us return to the internal forces, or, practically speaking, to the distribution of densities in the sea. We have here a direct cause of variation of surface-level, giving us, as it were, a theoretic or ideal sea-level at any particular place, largely affected in actual fact by extrinsic forces which move and heap up the waters. Now, we began by saying that mean sea-level, properly so-called, is a constant as yet undetermined. But, nevertheless, we know a very great deal more about it than we did even a few years ago, and can give a very fair approximation to it in a considerable number of localities. Even at Dundee or Aberdeen mean sea-level is a very different thing from

FIG. 2.—Mean sea-level, calculated values; referred (in centimetre-units) to a geoidic surface touching the North Sea in the middle of its northern part.

that mark at Liverpool from which all our Ordnance levels are reckoned, and which (though by a happy accident it is not far from the truth) we all know to be a purely empirical or conventional datum. Now, as Prof. Witting argues, we do already know enough about this subject to be able to define, with a fair amount of accuracy, a "zero-pressure level" in the sea at a point where no movements are caused by the distribution of densities; to be more specific, we may choose a point somewhere towards the middle of the northern part of the North Sea, describe a geoidic surface touching it, and call that (to the best of our present knowledge) our datum level. Proceeding outwards from this zero point, we may calculate the hydrodynamical part of the slope due to the distribution of densities; and again we may calculate, and superadd to this, the slope due to barometric pressures, either for some particular epoch or in average values corresponding with long-period barometric means. In Fig. 2 Prof. Witting shows, after this manner, the

calculated or hypothetic values of mean sea-level over the Baltic area, expressed in terms of deviation (or as isanomalies) from the geoidic surface defined above. It will be seen that these isanomalies are of an order of magnitude far beyond any probable errors in the determination of our base.

The next step, to be immediately taken, is to compare these *calculated* results with the *observed* results obtained by actual survey on land, with the most modern *nivellements de précision* achieved by the national Surveys. On this subject Prof. Witting has much to say, and he succeeds in showing that the two sets of results, the calculated and the observed, are wonderfully congruent. For example (and one example must suffice), Prof. Witting arrives by calculation at an estimated mean difference of sea-level between Marienleuchte, on the North Sea, and Arkona and Memel, in the Baltic, amounting respectively to +9·8 and +17 centimetres. The German *Präcisions-nivellierung* gives observed values of 11 and 17·6 centimetres. As good, or even better, agreement is shown between stations in the Baltic and Amsterdam, making use of the Dutch as well as the German levellings. In short, Prof. Witting has good right to boast that this part of oceanography has become an exact science, and that his "thalassographic levelling" bears favourable comparison with, and may even be used to check and to control, the most refined achievements of actual surveys on land.

FIG. 3.—The mean rate of elevation of the land during the period 1898–19 in centimetres per annum.

The last remaining matter which presents itself is the question of long-period fluctuations of sea-level and the whole subject of secular elevation or depression of the land. Here we start at a disadvantage, from our great ignorance of the variations in level of the ocean itself. But we do know a good deal by observation, and we may learn a good deal more by Prof. Witting's method of calculation of the *relative* variations of level at various points of the coast. There is no fixed point which we can designate, but Prof. Witting shows that for about a century the coastal variations in the southern Baltic must have been very small. Suppose, then, that the coast from Wismar to Pillau has, on the whole, kept a constant level; we may then map out the relative changes over the rest of the Baltic area (as in Fig. 3) during the period of years (1898–1912) over which Prof. Witting's work extends. The result is striking enough; but the story does not end there. There are, on one hand, minor fluctuations within the area itself, and some of them are related to seismic phenomena; for instance, there was an interruption in the general upheaval about the time of the Scandinavian earthquake of 1904. On the other hand, the phenomena are directly related to those exhibited outside the Baltic area; and it may be said that, though certain minor differences exist—for instance, in Holland—it is clear enough that the Fennoscandian upheaval is only part of a larger movement of the earth's crust, which extends at least as far as the Netherlands and Scotland. From England the author has to regret that no observations were available.

With these recent scientific results regarding the elevation of the Baltic coasts Prof. Witting goes on to compare the earlier historic records and the prehistoric evidence, such as it is, which is available from archæology and from geology. He finds that for some centuries past the elevation of the Fennoscandian lands has gone on at just about the same rate as to-day. The archæological evidence is more doubtful. It may be that the phenomenon has been approximately the same for some six thousand years; but it was possibly slower during and just after the Bronze age. Prof. Witting suggests—and this should interest the archæologists—that apparent contradictions would disappear if we might assume that the older relics are considerably older than Scandinavian archæologists are accustomed to consider them; and that, on the other hand, the Bronze age is not quite so old as it is commonly supposed to be. The more ancient phenomena are difficult to discuss, because a damming-up of the Baltic outlet may have produced results not to be distinguished from actual elevation of the lands within. But Prof. Witting believes that in the Littorina period there was certainly an interruption, and that probably just after the Glacial period there was an acceleration in the rate of elevation.

Prof. Witting brings a most interesting paper to a close with a strong plea for increased study of sea-levels and all the related phenomena, and for such international co-operation as is obviously essential for a complete and systematic investigation of the whole subject.

D'ARCY W. THOMPSON.

ENERGY DISTRIBUTION IN SPECTRA.[1]

OUR knowledge of the structure of very fine spectrum lines is now on a secure and nearly comprehensive basis, from the points of view of both theory and of experiment, and it is very remarkable that so little is known of the distribution of energy in these lines, either in individual lines or as between the different lines contained in the spectrum of any atom. The analysis of the spectra of atoms, theoretically and in the laboratory, is now recognised as the most critical test to which any theory of atomic structure can be subjected, and we have recently had theories of the atom entirely based upon the wave-lengths of the radiations which they emit. A question of equal importance, to which I now wish to direct your attention, is the relative amounts of energy which the atom throws out in the form of radiation in the different

[1] Discourse delivered at the Royal Institution on May 2 by Prof. J. W. Nicholson, F.R.S.

wave-lengths, for this is well known to vary in some cases very greatly according to the circumstances in which the atom is excited. I shall describe, in the first instance, a method designed by Dr. Merton for investigating the distribution of energy among spectrum lines, or in the breadth of an individual line, with great accuracy. It is possible by this means to obtain the long-desired object of an absolute scale of spectral intensity, independent of all the ordinary difficulties determined by such matters as the unequal behaviour of the photographic plate for light in different regions of the spectrum. Dr. Merton and I have been working together on this subject for the past three years, and I shall conclude the present lecture with an account of some of the more interesting results which have been reached, after an explanation of the method.

The intensities of spectrum lines have usually been recorded on an arbitrary scale. ranging between 10 and zero, the numbers assigned being at the discretion of the observer, and varying so greatly among different observers as frequently to be of little value for exact knowledge. They depend also very much on the nature of the observation, whether visual or photographic, and in the latter case on the region of the spectrum to which the line belongs. The sensitivity of a photographic plate varies with the wave-length of the light in a curious manner, and apparently an irregular one not following any simple law. The sensitivity of the eye is also different for different colours. When the line is outside the visible spectrum, in the infra-red or dark heat region, measurements of intensity can be made with some accuracy by a thermopile or a bolometer. But they are needed more urgently in the visible region at present, not only for the information they will afford regarding the nature of the atom, but also for application to other problems. The subject is very important, for instance, in the interpretation of celestial spectra, and more particularly those spectra of great complexity and variability which are associated with the birth of new stars, from which most of our knowledge regarding such stars must be constructed.

Previous knowledge of changes in spectral intensity under varying conditions was of necessity limited to the great changes. Those changes, which are of especial value in connections such as I have mentioned, are liable to be of a less conspicuous type, not readily capable of detection by the ordinary photographic or the visual method, and, if detected, not capable of accurate measurement.

In the visual region of the spectrum observations with the bolometer are not satisfactory. The source of light must be very intense in order to produce large deflections in the galvanometer, and only the brightest lines could be dealt with even in this way. Only one line in the spectrum can be experimented upon at one time, and the source of light cannot be maintained constant over a protracted period. The method is, in fact, quite unsuitable, and the spectrophotometer has been tried instead, but no great accuracy is possible, and its use is confined to a very narrow region of wave-length. Moreover, the variability of the source of light is again present.

In adopting any photographic method for quantitative work we must remember that not only does the sensitivity of the plate vary with the wave-length, but also that there is no very definite relation between the density of a photographic image and either the intensity of the light or the time of exposure. If we halve the former and double the latter, we do not get the same density of the image, but another which depends on the particular plate used. The grain of a plate also scatters light, and the actual size of the image thus depends on the exposure and the intensity of the light. We were early compelled to conclude that accurate measurements of intensity by a photographic method involve the necessity of an equal exposure on the same plate for all the sources of light to be compared, and the method to be described satisfies this necessity.

The spectrograph for producing and photographing the lines of a spectrum is set up in the usual way, which requires no description. A wedge of neutral-tinted glass, cemented to another of clear glass so as to form a plane parallel plate, is mounted in front of the slit. The image of the slit formed by light of any wave-length is thus attenuated towards the part of the slit opposite the thick end of the wedge, where the absorption of light is greatest, and the image ceases to be strong enough to affect the plate beyond a certain specific height, which depends on the original intensity, in the beam from the source, of this particular wave-length.

The photograph thus consists, not of the usual spectrum with all lines or slit-images of the same length, but of a spectrum in which all the lines are cut down to specific heights depending on the original intensities, and thus it gives a simultaneous record of all the intensities in the spectrum at any one instant. All spectrum lines have a breadth, due to the Doppler effect of the atomic motions in the kinetic theory, and to other agencies. The shape of one of the truncated lines depends on the original law of intensity across the line, and they may be wedge-shaped, or bounded by a more or less rounded curve, from the nature of which, if the boundary can be sharply defined, we can deduce mathematically the law of intensity across the original line. Sharp changes of intensity, such as occur when the line has several close components overlapping one another, are detected as peaks or kinks in this bounding curve. The original photograph can be enlarged with considerable magnifying power, and if the bounding curve on this enlargement is sharply defined, we can obtain its mathematical shape very accurately, and deduce an estimate of the intensity in any part of the line with a great degree of precision. We have been able to show that in most of our experiments such accuracy as 1 part in 100 has been reached, and it could readily be increased, if desired, by the use of greater magnification of the original photograph.

The determination of the exact boundary of a patch of dark on a white ground is a matter in which "personal equation" is important. We overcame this difficulty by enlarging positives, prepared from the negatives, on to bromide paper through a ruled "process" screen. The resulting photograph consists in this way of an assemblage of very minute dots, fading away towards the boundary into invisibility. It is a simple matter to prick out the last dots visible all round the contour, and in this way personal equation can apparently be entirely eliminated. We adopted usually about 100 dots to the inch on the final photograph. If comparisons of different lines with one another are required, only the central heights of the figures are necessary, and the topmost dot can be seen at once.

The first application of the method was to the intensity distribution in the lines of the hydrogen spectrum when a condensed discharge was passed through the exciting tube. It was known that with a condensed discharge the lines always appeared much broader, and we concluded that the best method of obtaining information as to the source of the effect was to examine the intensity distribution across the lines. Some remarkable contours were obtained, showing at once a clear distinction between this source of broadening and that associated with the Doppler effect.

The contours associated with the latter should be thin, symmetrical parabolas. Those we found were wedge-shaped, with definite kinks indicating the introduction of new component lines when the condenser was put into the circuit. The wedge shape indicates that the law of decrease of intensity from the centre of a component is exponential, and not the law of error as in the Doppler effect. By measuring the distances between the kinks, and knowing the magnification and a previous calibration of the wedge, all necessary quantitative data of the spectrum line can be calculated. It was possible to show in particular that the separations in wave-length of the components of H_α were those found by Stark when new components were called into being by the existence of an enormous external potential gradient. As we had suspected, the origin of this exceptional broadening under the condensed discharge is the "electric Zeeman effect," the origin of the large electric field on any atom being the close proximity of other charged atoms. We thus have a new means of studying the electrical resolution of spectral lines, more convenient in many ways than the older methods, and capable of much greater generality and accuracy. A large number of observations of the same phenomenon were made also on the spectral lines of helium and lithium, and the correspondence with the Stark effect always held good.

The examination of an individual line has also been applied in the case of an "ordinary" discharge, and has given the first direct proof of the probability distribution of velocities in the radiating atoms of a gas. This distribution was taken as a basis by Lord Rayleigh in the elaboration of a precise method of determining the mass of a radiating atom from the breadth of the spectrum lines—a method applied by Buisson and Fabry with great success, when the breadth is measured by methods of interference of light. Our experiments have defined very closely the circumstances in which this method is practicable, and shown that it fails altogether if condensed discharges are employed. In the ordinary uncondensed discharge under low pressure, however, our contours are very accurately parabolic, which fact can be shown to imply a very rigorous probability law of velocities in the atoms, and no other important source of broadening of lines in these circumstances.

The only other application to an individual line, which I shall mention concerns the nature of the Balmer series of hydrogen, long believed to be a diffuse series, with each line consisting of two close components, scarcely separable or not separable at all, with the same interval in frequency between them for every line. We have shown that it is in fact a principal series, with the separations decreasing in a calculable way required by theory, confirming also the value of the separation in H_α given by Fabry and Buisson. The method was to use the neutral wedge in combination with another apparatus of extreme resolving power—in this case a Lummer-Gehrcke plate. We can in this way obtain contours for a pair of close components which cannot be detected visually as a pair, and the actual interval can be deduced by a series of measurements of the joint contour, consisting of two overlapping parabolas. We calculate the position of the vertex of the inner one, and thence the separation, which can, in H_β, be determined within about 0·001 of an Ångström unit. The actual separation in this line is as small as 0·030 Å., and the present method could measure separations accurately, even if they were much smaller.

We pass now from the phenomena of structure and intensity of a single line to those involving a comparison of different lines. Here the behaviour of the plate for different wave-lengths must be dealt with. But it so happens that every plate can be calibrated by throwing on to it, not only the whole spectrum under examination, but also the radiation—a continuous spectrum—from the positive crater of the carbon arc. The energy distribution in this case is known from Wien's law when the temperature of the arc is known, as it is very closely. On the slide you will notice the curious contour bounding this spectrum, largely due to vagaries in the sensitivity of the plate. Above it is the helium spectrum on the same plate. To obtain an absolute scale of intensities down the helium spectrum, independent of all sources of error due to apparatus, we only need to compare the heights of the lines with the corresponding heights directly below them in the carbon-arc spectrum. It is, in fact, logarithms of intensity which the heights represent, and differences of height represent powers of a definite *factor* entering into the intensities, so that the photographs give no visual impression of the enormous differences of intensity which occur. For example, the line of wave-length λ 3888, a principal line in the helium spectrum, appears quite short on the photographs, but is actually the most intense in the spectrum. It happens to be in a region of wave-length where the plate is not sensitive. One of our conclusions is, in fact, that principal series deserve their name even in elements which appeared hitherto to be exceptions, in that they do contain, for the visible region, a preponderant part of the energy radiated

It is not necessary to use the carbon arc in every subsequent experiment. We can, by its means, calibrate the helium spectrum under conditions easily reproduced, and afterwards take this as our standard, especially when the work projected is the variation of the helium spectrum under changing conditions of excitation. Some of the remaining slides indicate the unexpected character of some of these variations. It would not be possible, in this discourse, to give anything like a complete account of the phenomena of this class already investigated, and I shall therefore confine myself to some of those which are most striking. In the first place, we may notice the spectrum of a mixture of hydrogen and helium or neon. The fundamental phenomenon which this method has detected is what we have called "transfer of energy along a series." For instance, in the Balmer series of hydrogen, produced from pure hydrogen under "ordinary" conditions, there is a perfectly definite intensity relation among the lines H_α, H_β, and so on, but in the presence of helium this is disturbed, and the ratios H_β/H_α, H_γ/H_β, are notably increased. In other words, more energy tends to be emitted in the form of the more refrangible rays, at the expense of the less refrangible. It is interesting to speculate as to how far this process can be carried, for its logical extreme is a radiation from hydrogen concentrated at λ 3646, the limit of the Balmer series. We have not, in fact, examined the matter from this point of view.

Neon produces the same effect on the hydrogen spectrum, the first recorded evidence being an experiment of Liveing and Dewar, who found in 1900 that it was possible to observe more of the violet members of the Balmer series when neon was present. We have made quantitative measurements of the effect in various cases, and in one experiment, for instance, the neon was found to make H_β 6/5 as strong, H_γ 9/5 as strong, and H_δ 11/5 as strong in comparison with H_α. But I shall not enter into further numerical detail. A particularly interesting fact is that the effect of a small trace of an impurity is often diametrically opposite to that of a large quantity, and causes the transfer of energy to take place in the opposite direction along the

spectrum. There are evidently two quite different mechanisms of interaction possible between the atoms of the two gases—a problem I commend to the chemist for investigation.

But it is not necessary to mix one gas with another in order to produce the energy transfer. It can be achieved otherwise, as some further slides I have here will suffice to show. We have made many measurements of intensity, more especially in the spectrum of pure helium, of the lines from a pure gas as dependent on the part of the tube they arise from, and on the conditions of excitation. We shall only consider one or two of the more interesting results which arise from a comparison of three spectra of helium: (1) the "ordinary" spectrum, or the spectrum given by the capillary of a vacuum tube containing helium at about a millimetre pressure, excited by the discharge from an induction coil without capacity or spark-gap; (2) the bulb spectrum, obtained by putting a small condenser and a very small spark-gap in parallel in the circuit; (3) the capillary spectrum with a spark-gap and a strong condensed discharge. In both (2) and (3) the transfer of energy to the more refrangible members of a series takes place very strongly. In the diffuse series the transferred energy goes in (3) mainly towards increased breadth of the line, but in (2) mainly towards enhanced central intensity—two quite distinct effects. The sharp and principal series show the same transfer quite definitely, though on a smaller scale, and the effect is in these cases more closely confined to enhancement of the central intensity.

The most striking enhancements produced by the condensed discharge in helium occur with the lines λ 4472 and λ 4388, which are precisely the helium lines apt to be found abnormally strongly in the spectra of some of the planetary nebulæ. Some other experiments we have made, on the spectrum of helium at very low pressure, indicate that these lines, together with the line λ 5015 more frequently quoted, are the strongly enhanced lines also in these circumstances. If the two sets of circumstances occur together, λ 5015 is not especially strong, but the others are enhanced for both reasons. We have, in fact, been able to demonstrate that the peculiar "nebular" spectrum of helium could be produced in the laboratory by a combination of the condensed discharge with an extremely low pressure.

I shall not discuss the spectra of gases as dependent, in their intensity relations, on pressure. The time required would be prohibitive, and my object is to indicate the range of work now open to precise investigation, rather than to give any complete account of the phenomena which the method has yet indicated or elucidated. One remark must, however, be made in connection with high-pressure spectra. We investigated the intensity distribution in a helium tube at the extraordinary pressure of 42 mm. Except for the trace of hydrogen which came out of the electrodes during the discharge, the helium was pure. Yet the hydrogen spectrum was nevertheless predominant on the plate, and fourteen members of the Balmer series, instead of the usual six or seven at most, could be seen visually as very sharp lines. This phenomenon incidentally cannot be reconciled with the current quantum theory of the hydrogen spectrum—perhaps not an unexpected fact to those conversant with the hydrogen spectrum. No atomic theory as yet has begun to interpret any of this spectrum except the Balmer series, and many have done this. No spectroscopist can, in fact, accept a theory which can give no hint of the origin of the so-called "secondary spectrum" of hydrogen, known to arise mainly from the atom, and, in the laboratory at least, the most important and extensive part of the spectrum. The elucidation of this spectrum is in many ways the most fundamental problem of physics, and far more fundamental than the Balmer series problem.

Many of the [illegible] problems of interest, which the possession of an acc[illegible] method of intensity determination in spectra enables us to attack, are mainly of astrophysical importance. There may be variations of intensity in the Fraunhofer lines accompanying other more readily perceived solar phenomena, for example, but of more urgent importance is the need for a series of photographic registers of the intensity across the whole spectrum of a new star at different stages of its history. It has not often been possible even to determine the actual number of component radiations, in an apparent broad band with a structure, emitted from such a star—at least with any real certainty. A method which automatically sifts out such bands and gives peaks on a photograph at all the maxima of intensity in the band may well be expected to contribute greatly to the elucidation of the phenomena taking place, which must in any case be totally different from anything known by our terrestrial experience.

The only other class of phenomenon depending for its elucidation on precise measures of intensity in spectrum lines, to which I shall refer with further illustrative slides, is the variation which takes place in the spectrum from a helium tube as we recede from the cathode. The slides serve to show the considerable differences which take place in the distribution of the various series, which are all emitted most strongly at unequal distances from the cathode. One very extraordinary result, shown clearly on the last slide, is the fact that there exists a narrow region of the tube in which the characteristic spark line λ 4686 is emitted simultaneously with the helium band spectrum—a circumstance which necessitates some readjustment of preconceived ideas.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. S. Lees, who was recently appointed University lecturer in thermodynamics, has been re-elected a fellow of St. John's College.

LONDON.—The following appointments have been made in connection with the newly instituted school of librarianship at University College, of which, as already stated, Dr. E. A. Baker is the director:—Bibliography, Mr. A. Esdaile; Cataloguing and Library Routine, Mr. W. R. B. Prideaux; Classification, Mr. W. C. B. Sayers; Public Library Law, Mr. H. W. Fovargue; Library Organisation, Mr. B. M. Headicar; Literary History, Dr. A. W. Chambers; Literary History and Book Selection, Dr. E. A. Baker; Palæography and Archives, Mr. H. Jenkinson; assistant to the director, Mr. L. F. Newcombe. The work of the school is to begin on October 1, but the formal opening will take place on October 8, at 5 o'clock, at the hands of Sir F. G. Kenyon, the director and principal librarian of the British Museum.

DR. S. W. PATTERSON has been appointed director of the Eliza Hall Institute of Research, in connection with the Melbourne Hospital.

MR. W. H. N. JAMES has been appointed head of the electrical engineering department of the Bradford Municipal Technical College.

MR. J. A. R. MARRIOTT has intimated to the vice-chancellor of the University of Oxford his intention to resign the secretaryship to the University Extension Delegacy in March next.

MR. M. H. HADDOCK, of the Doncaster Technical College, has been appointed county mining organiser for Leicestershire, and to have charge of the new mining institute and technical school at Coalville.

IT is proposed to erect a geological building in connection with the University of Wisconsin as a memorial to Dr. C. R. Van Hise, late president of the University, thus bringing together under one roof the departments of geology and mining engineering, and the State and Federal geological surveys.

IN connection with the New York Botanical Garden, which has well-equipped laboratories and an extensive horticultural library, a two-year course in practical gardening has been inaugurated for the purpose of providing careers for convalescent soldiers and sailors and to meet the increasing demand for trained gardeners.

THE following appointments to professorships in the University College of Wales, Aberystwyth, have been made :—*Physics:* Prof. G. Owen (University of New Zealand). *Mathematics:* Prof. W. H. Young (University of Liverpool). *Agriculture:* A. E. Jones (head of the Department of Agriculture, University of Wales). *Geology:* Capt. W. T. Pugh.

THE total number of higher education grants for ex-Service officers and men awarded by the Board of Education now amounts to 5400. The courses in respect of which grants have been awarded include more than 1000 for engineering and technological subjects, between 600 and 700 for classics, philosophy, and literature, and about an equal number for pure science and mathematics.

AN association has been formed in New York, called "The New York Association for the Advancement of Medical Education and Medical Science," the main objects of which are: To improve and amplify the methods of undergraduate teaching; to perfect plans for utilising the clinical material of the city for teaching purposes and to make use of teaching talent now unemployed; to bring about a working affiliation of the medical schools, hospitals, and laboratories, and the public health facilities of the city; and to initiate the establishment of a medical foundation in the city whereby funds may be secured to meet the financial requirements of all forms of medical education and investigation.

THE prospectus of the evening courses in technology at Leeds University for the session 1919–20 is now available. The arrangements announced are subject to revision in consequence of the special circumstances of the present time. Technological courses will be held, it is hoped, in the following departments of the University :—Civil, mechanical, and electrical engineering; coal-mining; textile and leather industries; colour chemistry and dyeing; and geology applied to sanitary and civil engineering. The evening courses in the department of textile industries, to refer in more detail to one department, are primarily designed to meet the requirements of persons who, having already passed through approved courses of study, wish to take up some particular line of research work, or to conduct trade investigations necessitating the use of special equipment.

THE Board of Agriculture and Fisheries announces that, as part of the Government schemes of higher education and training of ex-Service officers, provision is made by the Board for financial assistance for agricultural training by means of (*a*) grants for residential training with selected farmers in England and Wales, and (*b*) agricultural scholarships at approved universities or agricultural colleges in England or Wales. More than 1300 officers have now been approved for grants under (*a*), of whom more than 1000 are actually in training on farms, whilst 65 out of the 100 scholarships available under (*b*) have been awarded. In view of the numerous applications which are still being received, the Board has decided that no application either for a grant for training on a farm or for a scholarship can be entertained by them (1) from any officer who has been demobilised by July 31, 1919, unless the application has been lodged at the appropriate district directorate of the Ministry of Labour on or before August 31, 1919; and (2) from any officer who has not been demobilised by July 31, 1919, unless it is received by December 31, 1919, except in any case in which it can be shown that for military reasons the application could not have been made by that date. All applications from non-demobilised officers should be made as soon as possible. Particulars of these farm-training grants and agricultural scholarships and of the manner of making application are given in the Board's booklet, "Land Settlement in the Mother Country" (L.S.9), which can be obtained either from the Board's offices at 72 Victoria Street, London, S.W.1, or from any district directorate of the Appointments Department, Ministry of Labour. The address of the appropriate district directorate can be ascertained at any post office. Non-demobilised officers should make their applications on Army form Z15 or Navy form S1299. Warrant officers, non-commissioned officers, and men in the ranks of suitable educational promise are also eligible for these grants.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 28.—M. Léon Guignard in the chair.—A. **Laveran** and G. **Franchini**: Some flagellæ of insects obtained in a pure culture, and in particular *Crithidia melophagi*. Details of the technique for obtaining pure cultures are given, and proof of the pathogenic action on mice.—A. **Rateau**: The theory of aeroplanes: application to an example. —R. **de Forcrand** and F. **Taboury**: The stability of the sulphones formed by the iodides of sodium, rubidium, and cæsium. These compounds have the composition $MI+3SO_2$; their dissociation pressures have been measured at $-22\cdot5°$ C., $0°$ C., $+9\cdot65°$ C., and at $15°$ C., and the results are given in the form of curves.—N. E. **Nörlund**: The polynomials of Euler.—Ch. **Platrier**: The elastic equilibrium of a homogeneous isotropic body of revolution submitted to radial forces either proportional or inversely proportional to the radius.—H. **Abraham** and E. **Bloch**: Recording galvanometers with movable needle.—E. **Brylinski**: The induction reaction of alternators.—E. **Poirson**: A method of secret telephony. The telephonic currents are deformed by periodic interruptions by mechanical means, and the message cannot then be understood. The distorted currents can be rectified at the receiving end by a synchronised apparatus. Experiments have been carried out by this method with success over distances up to 600 km.—J. **Lavaux**: Electrolytic luminescence phenomena presented by certain metallic anodes.—Jh. **Martinet**: The indirubins.—Ch. **Chavanne** and L. J. **Simon**: The critical solution temperatures in aniline of mixtures of hydrocarbons. Application to the analyses of petrols.—H. **Colin** and O. **Liévin**: The spontaneous oxidation of complex organic compounds of cobalt. Alkaline solutions of glycerol or lactic acid containing cobalt absorb oxygen up to a maximum of one atom of oxygen for one atom of cobalt. Other substances, such as mannitol, erythritol, and glucose, under similar conditions absorb oxygen continuously beyond this limit.—P. **Russo**: The Eocene containing phos-

phate at Oued Zem (western Morocco).—G. **Reboul** and L. **Dunoyer**: The utilisation of temperature for the prediction of barometric variations.—L. **Blaringhem**: Floral variations in the large marguerite, *Leucanthemum vulgare*.—Mme. E. **Bloch**: Anatomical modifications of roots by mechanical action. Compression causes important local modifications, but the general development of the plant is uninfluenced, flowers and fruit remaining normal.—H. **Bierry**: Food ration. The minimum requirements of sugar and of fat.—L. **Vialleton**: The epiphyses and cartilage of conjugation in mammals.—A. **Paillot**: The cytology of the blood of the caterpillars of the Macrolepidoptera.

CALCUTTA.

Asiatic Society of Bengal, July 2.—G. R. **Kaye**: Hindu astronomical deities. This paper deals primarily with the navagraha or nine planets and the planetary cult as it obtains in India. It also refers to a separate solar worship which is traced back to Vedic influences, while it is indicated that the planetary cult proper is possibly of exotic origin. Details of planetary iconography are given which are traced to Paurānic teaching, and are illustrated by photographs of ancient sculptures of the navagraha, and extracts from early texts and inscriptions; and these details are contrasted with the modern practice as exhibited in paddhatis and pañchāṅgas.—H. B. **Hannay**: Note on ancient Romic chronology. The paper indicates the nature of the sothic cycle, starting from zero at the autumnal equinox as understood by the ancient Egyptians; also the nature, length, and practical significance of the Sed and Hunti Hebs, or festivals, as based on that cycle; it shows that all official and other data from monuments, etc., regarding sothic risings, hebs, etc., are placeable in the cycle.

BOOKS RECEIVED.

Board of Agriculture and Fisheries: Guides to Smallholders. No. 2: Dairy Farming under Smallholding Conditions. (London: Board of Agriculture and Fisheries, 1919.) 2*d.*

Experimental Researches carried out in the Department of Glass Technology, University of Sheffield. (Reprinted from the Journal of the Society of Glass Technology.) Pp. iii+178. (Sheffield: The University, n.d.)

The Stars Night by Night: Being the Journal of a Star Gazer. By J. H. Elgie. First published as "Night Skies of a Year," 1910. Pp. xiv+247. (London: C. Arthur Pearson, Ltd., 1919.) 1*s.* 6*d.* net.

Problems of Fertilisation. By Prof. F. R. Lillie. (University of Chicago Science Series.) Pp. xii+278. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1.75 dollars.

A Source Book of Biological Nature-Study. By E. R. Downing. (University of Chicago Nature-Study Series.) Pp. xxi+503. (Chicago: University of Chicago Press; London: Cambridge University Press, 1919.) 3 dollars.

Mining and Manufacture of Fertilising Materials and their Relation to Soils. By S. E. Lloyd. Pp. vi+153. (New York: D. Van Nostrand Co.; London: Crosby Lockwood and Son, 1919.) 9*s.* net.

Mathematics for Collegiate Students of Agriculture and General Science. By Profs. A. M. Kenyon and W. V. Lovitt. Revised edition. Pp. vii+337. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) 10*s.* 6*d.* net.

The Whole Truth about Alcohol. By G. E. Flint. With an introduction by Dr. A. Jacobi. Pp. xii+294. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) 6*s.* net.

Lectures on the Principle of Symmetry and its Applications in all Natural Sciences. By Prof. F. M. Jaeger. Pp. xii+333. (Amsterdam: "Elsevier" Publishing Co.; London: Cambridge University Press, 1917.) 20*s.* net.

Medicine and Nursing. By Sir William Osler. (Essays on Vocation.) Pp. 12. (London: Humphrey Milford; Oxford University Press, 1919.) 6*d.* net.

Annual Reports of the New York State College of Agriculture at Cornell University and the Agricultural Experiment Station, established under the direction of Cornell University, Ithaca, New York. Vol. i., 1914. Pp. clxxxii+1140+13. Vol. i., 1915. Pp. lxxxix+996+8. Vol. i., 1916. Pp. lxxxvii+827+7. Vol. i., 1917. Pp. xc+1183+8. (Ithaca: Published by the University, 1915–18.)

House of Representatives: Library of Congress. Report of the Librarian of Congress and Report of the Superintendent of the Library Building and Grounds for the Fiscal Year ending June 30, 1918. Pp. 191. (Washington: Government Printing Office, 1918.) 45 cents.

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THURSDAY, AUGUST 28, 1919.

WAR WOUNDS.

(1) *Traité Clinique de Neurologie de Guerre.* Par Paul Sollier, Chartier, Félix Rose, Villandre. Préface de M. le Médecin-Inspecteur Baratte. Pp. viii + 830. (Paris: Librairie Félix Alcan, 1918.) Price 32 francs.

(2) *Annales de la Clinique Chirurgicale du Prof. Pierre Delbet.* No. 6. *Biologie de la Plaie de Guerre.* Par Prof. Pierre Delbet et Noël Fiessinger. Pp. v + 460 + 4 pls. (Paris: Librairie Félix Alcan, 1918.) Price 30 francs.

(1) THE publication of the work carried out in the Neurological Centre of the Fourteenth Region (Lyons) during the period December, 1914, to March, 1918, is a welcome addition to the neurological records of the war. More than 18,000 patients were examined during this time, and nearly half of these were actually in hospital under the care of the staff of the Centre. More than 11,000 cases were followed up, and the statistics of these are available.

The organisation of the Centre, with its many special departments, under one administrative head, has ensured a unity of purpose during the whole time of the patients' treatment. The co-ordination of special medical and surgical departments with those of radiology, electro-therapeutics, re-education, etc., is especially insisted upon. In this country the chief attempt at such co-ordination has come through the establishment of special hospitals for orthopædic cases, and such units have been an unqualified success.

M. Chartier discusses head wounds, and notes that the use of the steel helmet not only reduced the incidence of such wounds, but also diminished the proportion of severe penetrating wounds of the skull. It is emphasised that foreign bodies after lying latent in the brain for months may at length give rise to serious cerebral conditions, such as abscess or apoplexy.

The ordinary facts of cerebral anatomy and physiology are shortly described in relation to lesions of the brain. Reference to the work of Head and Holmes is omitted in the description of the cerebral sensory functions. The classification of aphasia according to Marie and Foix is adopted, although no new facts are mentioned. Traumatic diabetes and polyuria are shortly dealt with, although the influence of the sympathetic nervous system and adrenal glands receives no recognition as playing an important part in the production of this form of glycosuria.

M. Villandre ably deals with the surgical treatment of head wounds, including late repair of the skull by bone and cartilage grafts. A feature of this section is the full description of X-ray diagnosis. This author also gives an account of the surgery of the spinal cord, with details as to technique.

The chief diseases and injuries of the spinal cord and plexuses are described by Dr. Félix Rose. The diagnosis is not very fully discussed, a notable omission being the bulbo-cavernosus reflex in the diagnosis of injuries to the cauda equina. The paragraphs on polyneuritis do not describe cases with symptoms similar to those recently published as "infective polyneuritis" by British observers.

M. Chartier gives an account of the lesions of the cranial nerves and those of the upper extremity. The anatomical arrangement of nerve-fibres in peripheral nerves is mentioned in connection with the work of Dejerine and Mouzon and that of Marie and Meige; no personal experiences are given. Most observers in this country would dispute the statement that in complete lesions of the median nerve the nail pulp of the middle finger remains sensitive to pressure pain. The periarterial sympathetic fibres are suggested as the pathway for this sensation, although no proof of this view is attempted.

In the section on "Causalgia" singularly little personal experience is quoted, and the sympathetic system is again called in to explain the important features of this syndrome. The original suggestions of Weir Mitchell are much more in line with the clinical findings in these cases, and the treatment by removal of the sympathetic nerves as advocated by Leriche has not been a success in this country. The author does not mention the frequent innervation of muscles such as the first dorsal interosseous in the hand by other nerves than those usually described, a fact which may complicate both diagnosis and prognosis.

All observers in this country are much struck with the manner in which the function of paralysed muscles can be taken on by alternative muscles not usually associated with the chief movements of joints. M. Chartier does not emphasise these phenomena in connection with diagnosis and prognosis.

MM. Villandre and Sollier deal with the surgical and medical treatment of nerve injuries respectively. Before operation they insist upon neurological, electrical, and, if necessary, X-ray reports. An interval of two and a half to three months is allowed to elapse after the healing of the wound before nerve suture is undertaken. There is no insistence upon re-examination at regular intervals for signs of regeneration, although this routine is essential to accurate treatment. The section on electro-diagnosis is complete. The ordinary tests by faradism and galvanism have been most used, although the condenser and chronaxie methods are mentioned.

The chapters by P. Sollier on the functional disorders are the most interesting in the whole work. Personal experience is freely quoted in the text, which is also well illustrated by original photographs. The writer objects to the view that the basis of all "functional" disorder is "psychic." The physiological basis of hysteria is stated in full. In common with Roussy,

L'hermitte, and others in France, and Hurst in this country, Sollier declares that the "reflex" or "physiopathic" cases described by Babinski and Froment are easily curable by mobilisation and psychotherapy. The muscular and vaso-motor changes, etc., are believed to be entirely due to immobility, and clear up as soon as the use of the affected limb is restored. A return to Charcot's conception of hysteria is predicted by Sollier as the result of war experiences. Careful distinction is made between true reflex contractures associated with pain, and those called "reflex" by Babinski and Froment. All varieties of functional disorder, including those of the special senses, are described. Treatment by mobilisation and isolation is recommended, while the exclusion of splints, massage, electrotherapy, etc., is urged.

The section which deals with re-education is instructive. The organisation of the re-education treatment seems to have been excellent. The early individual treatment by the physician is succeeded by exercises under a masseur, who is himself carefully supervised by the physician. The next stage is that of gymnastic drill under medical supervision, in which chosen N.C.O.'s and patients assist. Finally, uncontrolled military drill completes the "hardening process" to fit the soldier for military duty. The use of carefully supervised physical work, as in our own "curative workshops," and of games, also forms part of the routine.

The value of mechano-therapy is contrasted with that of motor re-education, to the great advantage of the latter, which is found to be an active, living mode of treatment when crowned by curative work.

(2) The authors publish in this volume the results of their careful studies of tissues damaged by war wounds. They have been able to make parallel observations upon the tissue cells and the bacterial flora of wounds, so that much useful information is available. The deductions that they have drawn from the various changes found are clearly expressed, and a fearless criticism of the recent antiseptic methods of wound treatment is made.

The opening section is devoted to a description of the lesions, emphasis being laid upon the important part played by damaged muscle as a culture medium for bacteria. The process of myolysis by ferments is described, and stress is laid upon the fact that the simple protein bodies resulting from the process, viz. peptones and amino-acids, favour bacterial growth to a greater degree than do the albumins. During the first four to twelve hours after the trauma the infection is little marked, and at this period such a wound might be capable of transformation into a surgical wound with union by first intention.

In the nature of the infection an important place is given to the anaerobes. The bacillus of malignant œdema (*vibrion septique*), bacillus aerogenes capsulatus (*B. welchii*), with the whole series of anaerobes, obtain the expected recognition in the description of the infection. The aerobic organisms appear in wounds after the anaerobic series has been observed for some hours previously. The streptococcus is found to be the most dangerous of the aerobic series, especially in the usual state of mixed infection, when proteolytic changes greatly favour its growth. The defence in all its aspects is fully and clearly discussed.

Leucocytic changes as seen by vital staining methods, serum reactions, antitoxins, and ferment actions are all included in the study of the defence mechanism. The changes which result in the breakdown of the defence, and the production of gas gangrene, are fully dealt with, and emphasis is laid upon the fact that the nature of the infection rather than bacterial quantity is the important factor with which the tissue cells have to deal.

The section on therapeutics mentions every known means of meeting infection, and each measure is fully criticised. As a result of their wide researches, especially those directed to the study of infected excised tissues, the authors urge that the best treatment for war wounds is the early excision of all damaged tissue, followed by primary suture. The authors insist upon the early work of Gaudier in October, 1915, in connection with wound incision, and they claim that, as 85 per cent. of the wounds can be safely excised and sutured, other treatment, such as irrigation with antiseptics, is superfluous.

The action of chemical agents is carefully analysed until their futility is obvious. The Carrel-Dakin technique is severely handled by the authors, the solution itself being characterised as a "chemical bistoury which acts by proteolysis of mortified tissue." The general therapeutic conclusions are that damaged tissues and their infection play the most important part in war wounds. Excision of lacerated muscle, etc., and the conversion of the wound into an ordinary surgical wound, are the greatest advances in wound treatment. Local treatment is most important, although general measures, such as vaccines and sera, may help in selected cases.

J. le Fleming Burrow.

THE FACE OF THE EARTH.

La Face de la Terre (*Das Antlitz der Erde*). Par Prof. Ed. Suess. Traduit de l'Allemand avec l'Autorisation de l'Auteur et Annoté sous la Direction de Emm. de Margerie. Tome iii., 4e Partie. (Fin.) Avec un Epilogue par P. Termier. Pp. xvi+1361–1724. Tables Générales de l'Ouvrage. Tomes i., ii., iii. (1re, 2e, 3e et 4e Parties.) (Paris: Librairie Armand Colin, 1918.) Price 25 francs.

THIS is a noble ending to a noble work. On the merits of the original it is scarcely necessary to enlarge; since they were first recognised in these pages they have become familiar

to all English geologists, and the fame of "Das Antlitz" has spread over the whole world. Yet time has increased, rather than diminished, our appreciation of its great qualities, and we take advantage of this opportunity to express our admiration for its superb mastery over detail and the acute vision which have combined to give us in true perspective so many faithful pictures of terrestrial structure; for its power of synthesis, discovering in the midst of the most diverse phenomena an underlying unity; for its freshness of explanation, always surprising us with novel theories and hypotheses; and for many bold conceptions, which, whether we accept them or not, are always valuable for what they suggest if for nothing else. The delight with which we follow the author through the most complicated descriptions or discussions is increased by the vigour of his language, with its occasional ascent into spontaneous eloquence under the inspiration of great ideas. As we read, we are conscious of a new spirit which has broken loose from ancient dogmas and leads us forth to fresh conquests of the unknown.

It was the French geologists who were the first to welcome the appearance of the new geology and undertook the translation of "Das Antlitz" into their language under the direction of M. Emmanuel de Margerie. The first volume of "La Face de la Terre" appeared in 1897; it opens with a thoughtful and appreciative preface by Marcel Bertrand. The last part was published last year (1918). It fitly concludes with an eloquent eulogy by M. Pierre Termier.

"La Face de la Terre" is an improvement on the original. As a translation it is absolutely faithful, and in the hands of masters of French prose like M. de Margerie and his colleagues, it gains by the added grace and lucidity which are inseparable from the French language. But it is much more than a translation; by the addition of numerous footnotes and illustrations it becomes a new edition.

The added illustrations are particularly welcome, those of the original work being wholly inadequate. Suess, when he wrote his masterly descriptions, had a mass of material, maps, sections, and drawings before his eyes, but, limited probably by considerations of expense, he introduced only 168 figures into the text. The French have given us more than thrice this number (in all 552 figures), and yet without greatly increasing the price. Even with this wealth of illustration we are not content, and still ask for more, especially for a few simple diagrams which would enable us to grasp with greater facility some of the new conceptions with which the work abounds.

The added notes, which are distinguished from those in the original by square brackets, are of great value; they bring the bibliographical references up to date, and when necessary point out how far the author's conclusions must be modified in the light of later knowledge.

The English translation, which was commenced (in 1904) much later than the French, and completed, so far as the body of the work is concerned, much earlier (in 1908), contains no new matter. We may hope that it will be supplemented by an atlas at some future date; meanwhile the student must have recourse to the French edition. That the English translation does not yet possess an index is a consequence of the war; the MS. has been in the hands of the printers for many years past.

The last part of the third volume of "La Face de la Terre," which is the immediate subject of this review, fully maintains the high standard of its predecessors. The first chapter, entitled "Analysis," presents us with an admirable survey of the structural features of mountain chains as revealed by a long series of brilliant investigations, which, begun long ago by Lapworth, were continued by Peach and Horne at home, and by numerous observers abroad, among whom Bertrand and Lugeon are pre-eminent. What a surprising revolution has been accomplished in our knowledge will be understood at a glance if we turn to the section across the Alps represented in Fig. 340 on p. 1448, where we are shown how the accumulated sediments of ancient seas have been transported in successive flows which have carried them many miles from their source and repeatedly doubled them one over the other in long, flat-lying folds. A satisfactory explanation of this phenomenon is still to seek; theory is completely outdistanced by observation.

The next chapter, entitled "The Depths," casts a penetrating glance into the interior of the earth and throws light on the various forms of igneous activity within the crust. A chapter on "The Origin and Distribution of Volcanoes" follows; it includes a brief account of the diamond pipes of South Africa. Then comes a chapter on "The Moon: Various Hypotheses and a Retrospect." In this we meet with some valuable suggestions on the question of isostasy. The illustrations added in the French edition are nowhere more welcome than in this place. The discussion of isostasy involves, however, mathematical treatment with which Suess does not seem to have been familiar, otherwise he would have scarcely proposed to neglect that factor in the reduction of observations which is commonly known as the Bourgeur correction, for, as Col. Lenox Conyngham has remarked, such a proposal is equivalent to asserting that it makes no difference whether the pendulum observations were made on a lofty tableland or in a balloon poised at the same altitude over a plain at sea-level.

The last chapter, "La Vie," is devoted to many interesting reflections on sundry problems concerned with the history of life on the globe, the migrations of faunas, and the preservation, amidst the revolutions of land and sea, of living beings in places of refuge or "asylums," the situation of which and their geological characters afford interesting material for discussion.

In concluding, we would ally ourselves with M. Termier in his admiration for this monumental treatise and, adopting as nearly as possible his own words, we may say: "Such a work is destined to endure, not for an age, but for all time. If it grows old it does so only very slowly, and preserves in its old age the majesty and beauty of things imperishable." W. J. SOLLAS.

PHYSIOLOGICAL CHEMISTRY.

(1) *Fats and Fatty Degeneration: A Physico-Chemical Study of Emulsions and the Normal and Abnormal Distribution of Fat in Protoplasm.* By Prof. Martin H. Fischer and Dr. Marian O. Hooker. Pp. ix+155. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 9*s.* 6*d.* net.

(2) *Practical Physiological Chemistry.* By Sydney W. Cole. Fifth edition. With an introduction by Prof. F. G. Hopkins. Pp. xvi+401. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall, Hamilton, Kent, and Co., Ltd., 1919.) Price 15*s.* net.

(1) LIKE Prof. Fischer's earlier studies on œdema and nephritis, this work on fatty degeneration and allied topics is suggestive and stimulating, but unsatisfactory. As before, we have, in the first place, a study of phenomena produced *in vitro*, in this case on the formation of various types of emulsion and on the factors leading to their stabilisation or "breaking." The observations are of no particular novelty, but they are well arranged from the point of view of popular demonstration. Passing to the condition in which fat is held in the protoplasm of the normal cell, and of that which has become the subject of fatty degeneration, the authors emphasise, with justice, the fact that the latter may contain actually no more fat than the former. This consideration gives an opening to Prof. Fischer's predilection for facile analogy. The comparison between the appearance in obvious droplets of fat previously invisible, and the "breaking" of a fine emulsion, is obvious and suggestive. But the recognition of a superficial similarity is a long way from a scientific demonstration of identity. On the authors' own showing, it is difficult to see why the post-mortem development of acidity, which is far in excess of any which can occur during life, does not produce the appearance of extreme fatty infiltration in every cell submitted to histological examination.

The mimicry of mucous secretion, by the effect of water on an emulsion of powdered gum in oil, has about the same scientific value. But the method surely leads the authors beyond all permissible limits in the chapter on "The Mimicry of Some Anatomical Structures." The suggestion that a soap solution beaten to fine foam with air looks, under the microscope, "not unlike a microscopic section of lung," or that the figures produced in the drying of an oil-in-soap emulsion "remind one of the rods and cones of the retina," seems to be much on the same level as a child's discovery of trees in a frosted window-pane, or of animal forms in the clouds. Are the authors trying to play Hamlet to the reader's Polonius, or do they wish to be taken seriously?

(2) Mr. Cole's valuable book, after being out of print for more than a year, now reappears in a fifth edition, with extensive revision and additions. The new chapter on the properties of solutions contains a full account of the method of determining hydrogen-ion concentrations by means of standard solutions and the range of indicators now available. This, like many other items in the book, will be of value to workers in many departments of biological science in which quantitative chemical methods are required. The instructions for preparing collodion sacs for dialysis, in the same chapter, could be improved by including some of the technical advances made in recent years by Walpole and by Brown. A properly made membrane of this kind surely becomes impermeable rather than porous on drying.

A large part of the book is still devoted to quantitative methods, and these are described with admirable clarity of detail. While the range of alternative methods in some instances might be thought to overburden a student's course, it greatly enhances the value of the book to the worker in a clinical or research laboratory. There is internal evidence, in almost every description of a method, that the working has been confirmed by personal experience; the book abounds in those valuable hints and practical details which come only from actual trial, and the absence of which renders many a laborious compilation so unsatisfactory. The directions for preparing certain amino-acids may be mentioned as remarkably good in this way; and, since this chapter is admittedly beyond the scope of ordinary class-work, it may be hoped that Mr. Cole, in a future edition, will increase the obligation of those needing pure amino-acids for bacteriological and other work, by extending the list of preparations. H. H. D.

OUR BOOKSHELF.

L'Insidia Sottomarina e Come fu Debellata, con Notizie sul Recupero delle Navi affondate. By Rear-Admiral E. Bravetta. Pp. vii+461. (Milan: Ulrico Hoepli, 1919.)

OF the hundreds of war-books published purporting to explain in a popular manner the work of the Allied Navies in tracking down and destroying U-boats, there are few, if any, which tell the public of the means adopted. Most books of the kind are merely suggestive, and much is left to the imagination. The present volume, by Admiral Bravetta, who is probably Italy's most distinguished writer on naval affairs, is far in advance of existing works of a similar kind.

So far as is permitted by reasons of military secrecy, Admiral Bravetta explains first of all the functions of the submarine, how this type of craft

is built, the kind of engines used to propel it when cruising on the surface and when submerged, the armament, and many other details. All his explanations are well illustrated. After a brief discussion of the tactics of the submarine, the book goes on to describe and illustrate a great number of devices employed—not all successfully—to track and destroy the U-boat. There are many American devices the value of which has probably been exaggerated—indeed, some of them are merely fantastical suggestions—and these, with others, are given to render the work complete. The concluding portion of the book deals with the many plans that have been put forward from time to time for salving sunken ships or their cargoes. Here, again, it remains for experience to show whether any of them are of value. It is not claimed that Admiral Bravetta's work can be of practical technical value, but as a well written and illustrated record of the achievements of human ingenuity in combating a menace to the world's safety it is well worth perusal by all who are able to follow semi-technical Italian. In fact, an English translation might well fill a want until some similar work is compiled in our own language. E. S. H.

Birdland's Little People: Twelve Nature Studies for Children. By Capt. Oliver G. Pike. Pp. 123. (London: The Religious Tract Society, 1919.) Price 4*s*. 6*d*. net.

The author of this volume is well known as a popular writer on natural history, and presents in the work before us an excellent series of essays, written in an interesting style, on the habits and haunts of several of the most attractive members of the British avifauna. The subjects are well chosen, and include certain feathered denizens of our gardens, lanes and copses, the reedy lake and the breezy moorland. In each case the love-making, nest-building, and subsequent care of eggs and young nestlings are described graphically from personal observation, so that the book is not a mere compilation, but a vivid account of bird-life written with the enthusiasm of a true lover of feathered creatures and their entrancing ways. The book will interest any boy or girl possessing a fondness for animal life (and this, we fancy, includes the majority of young people), while at the same time the various phenomena are so accurately and carefully described that persons of maturer years may read its pages with advantage. The birds selected include two species of grebe, two of warbler, the kingfisher, dipper, brown owl, lapwing, wren, cuckoo, whitethroat, great tit, and buzzard. The parasitic habits of the cuckoo, the cannibalistic propensities of a young buzzard, and the mysteries of migration are among the more interesting phenomena touched upon in a book which is well printed and illustrated by a series of twenty-four excellent reproductions of photographs taken from Nature by the author himself.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Velocity of Electric Currents.

While the velocity of electric waves is well known, as Maxwell and Heaviside have pointed out, we know absolutely nothing of the velocity with which electricity travels in a wire. As Heaviside says ("Papers," vol. ii., p. 3, line 4):—"It may be an inch an hour or it may be immensely great."

Mr. Aston's extremely interesting discovery (Nature, June 5, p. 275), that the striæ in capillary tubes containing neon or helium travel with approximately the same velocity as that of sound in the gas, is of interest in connection with the fact pointed out by the writer in *Science* for July 22, 1892, and more fully in the *Physical Review* for March, 1900, that "resistances of equi-molecular wires of pure metals are proportional to their transmission times for sound-waves" (to an accuracy of about 3 per cent.), and is in line with the suggestion made in the *Physical Review* paper referred to (March, 1900), that the time of travel of electricity in wires is the same as that of sound.

The double coincidence for metals and gases is at least suggestive, and further work along these lines might give results of interest.

If cohesion depends on the electrons in the outer rings, the tensile strength of the lead isotopes should be the same; but might not their electrical resistance and sound velocities (easily determined for small quantities of material by resonance methods) afford a means of distinguishing them?

Reginald A. Fessenden.

185 Franklin Street, Boston, Mass., U.S.A., August 5.

The Magnetic Storm of August 11–12, 1919.

The earlier months of 1919 showed a great deal of magnetic disturbance, but for some two months past conditions have been unusually quiet. On the morning of August 11, at about 7h. G.M.T., there was a "sudden commencement," followed by the largest magnetic storm experienced for some years at Kew Observatory. Conditions remained highly disturbed until near 10h. on August 12, when the photographic sheets were changed. The range in declination was 2° 5′, and that in vertical force 935 γ. The horizontal-force trace was twice beyond the limits of registration, on each occasion for more than ten minutes; thus the range shown, 840 γ, may have been considerably exceeded. Many of the movements were too rapid to be shown clearly in the trace. Rapid oscillations were especially in evidence between 7h. and 10h., and again between 14h. and 18h., on August 11. The declination curve also showed smaller but very rapid oscillations from midnight to 9h. of August 12. The extreme easterly reading, 13° 44′ W., was recorded at about 8h. of August 11, and the extreme westerly reading, 15° 49′ W., at about 16h. 32m.

The commencing movements near 7h. of August 11

were of an unusual character. In declination swings of 10′ to west, 20′ to east, and again 62′ to west followed in immediate succession. In horizontal force there was, as usual at the start, a rapid rise, amounting to 75γ; but in less than a minute the movement was reversed, and a fall exceeding 450γ in less than twelve minutes took the trace off the sheet. Horizontal force remained depressed for nearly 1½ hours, but then for a few minutes it was above the normal value. Another large fall then ensued, which carried the trace off the sheet from 9h. 15m. to 9h. 25m. Between 14h. and 17h. of August 11 horizontal force was usually above the normal. The maximum, which appeared synchronously with that in vertical force at about 16h. 2m., exceeded the value prior to the sudden commencement by 460γ. The disturbance in vertical force, though exceptionally large, was of the usual type. During the afternoon of August 11, from 14h. to 18h., the curve was of a pyramidal shape, the value of the element being much enhanced. By 23h. the curve had resumed its normal level, and a depression then set in, the minimum being reached just after 2h. on August 12.

The ranges recorded during this storm have seldom been approached at Kew Observatory. In fact, it is unlikely that so large a range has ever been recorded there before in vertical force. But for the great reduction in sensitiveness made of late years to meet the conditions caused by electric trains and trams, the maximum would have been far beyond the limits of registration.

C. CHREE.

Kew Observatory, Richmond, Surrey, August 13.

THE magnetic storm which began on the morning of August 11 was one of the largest recorded in recent years, and was probably of world-wide distribution. It attracted public attention chiefly through the notable—though not unusual—extent to which it interfered with telegraphic work. On account of its somewhat exceptional features, the following statement of results of observations at Eskdalemuir Observatory may be of some interest, and is communicated by permission of the Director, Meteorological Office.

The times given below are Greenwich mean times. The unit of 1γ is 0·00001 C.G.S. It should also be mentioned that the principal magnetographs at Eskdalemuir are so arranged as to give directly the vertical (V), north (N), and west (W) components of terrestrial force; a declination magnetograph is also in operation.

The conditions prior to the advent of the storm were those of a magnetically quiet day. Very slight disturbance was recorded between 20h. and 21h. on August 10, and pulsations of about three minutes' period were observed on N about an hour after midnight. The beginning of the storm as observed at Eskdalemuir may be taken as having occurred at 6h. 58m. on August 11. But this beginning differed very considerably in its character from the usual type of what is known as a "sudden commencement." Ordinarily, this phenomenon exhibits a rise in the value of the horizontal force; a rise also, though usually smaller, in declination; and in some instances a fall in the value of the downward directed vertical force. So far as is known, these abrupt changes take place simultaneously at any one place, and (in spite of attempts to prove the contrary) there is no trustworthy evidence to show that they are not synchronous at all observatories. In the case of the storm now considered, however, a minor disturbance of somewhat unusual type began on the north component thirty-two minutes before the other components experienced the sudden commencement of the storm. There is nothing to show that this minor disturbance had any relation to subsequent events or was other than "accidental," but it is mentioned for what it may be worth, and as being the cause of a doubtful estimate as to the time of the sudden commencement on the north component. At all events, the disturbance began at 6h. 58m. so suddenly as to send the light spot completely off the recording sheet, and did so with such rapidity that it is impossible to state whether the change was one of increase or decrease in force. But while there is no photographic trace immediately after 6h. 58m. on the + side of the undisturbed value, there is distinct evidence of its being *below* that value within a minute after that time. In another respect, the beginning of the storm was altogether exceptional in that the sudden commencement on the vertical-force magnetograph showed but the faintest trace of any decrease in value, and in reality was followed by a large increase. On the west component record there is shown a sudden rise and fall, the difference between the extremes being 172γ.

After the rapid changes associated with the sudden commencement of the storm, the first minimum value of N occurred at some time between 7h. and 7h. 30m., the trace being off the sheet in that interval. The first maximum value of W after the sudden commencement was at 7h. 10m., when it reached 188γ above the undisturbed value. The declination at this time was 1° 18′ to westward of its amount before the storm began. The vertical force rose to a maximum at 7h. 13m., it being then 44γ above its undisturbed value. Then followed a fall, on which were superposed numerous pulsations, to a minimum at 7h. 39m., and a recovery to a maximum 66γ above the undisturbed value at 7h. 58m. Such changes in V during the early part of the storm are entirely unusual, both in character and amount.

During a magnetic storm the value of the vertical force usually rises to a maximum about 17h., the rise occupying about four hours, and being gradual though irregular. In the present instance, after the first few hours of the storm had passed, during which time the oscillations in V were unusually rapid, the value rose suddenly at 14h. 28m., the trace leaving the sheet at 14h. 55m., having risen 250γ in this interval of twenty-seven minutes.

Other unusual features of the storm may be referred to, and one of these is the early hour at which the fall, after the maximum, in V took place. Usually this occurs about midnight, and includes two sudden drops in value. In the present case both occurred at unusually early hours, the first beginning at 19h. 22m., the second at 23h. 9m. The gradual recovery of the vertical force to its normal value is occasionally accompanied by pulsations. These were prominent on the morning of August 12. For example, during half an hour after 5h. thirteen oscillations were recorded with a mean amplitude of 4γ. Another noteworthy feature of the storm was the intense agitation ("internal activity") in the horizontal components, especially after 2h. on August 12. As a rule, this is more prominent during the daylight hours of a storm; here it occurred during the night hours. Lastly, the disturbance was peculiar in the suddenness with which it ended about 19h. on August 12, and in the magnetically quiet conditions which succeeded it.

A. CRICHTON MITCHELL.

Eskdalemuir Observatory, August 14.

THE JAMES WATT CENTENARY COMMEMORATION AT BIRMINGHAM.

THE arrangements for the James Watt centenary commemoration are now practically complete, the general scheme being set forth in a pamphlet issued by the Centenary Committee. The form which the memorial is to take is threefold:—(1) To endow a professorship of engineering, to be known as the James Watt chair, at the University of Birmingham, for the promotion of research in the fundamental principles underlying the production of power, and the study of the conservation of the natural sources of energy; (2) to erect a James Watt memorial building to serve as a museum for collecting together examples of the work of James Watt and his contemporaries, Boulton and Murdock, as a meeting place and library for scientific and technical societies, and as a centre from which engineers could co-operate in spreading scientific knowledge; and (3) to publish a memorial volume.

The success of the memorial will depend upon the response to the appeal for funds, and we are glad to note that assurances of support have come not only from all parts of the British Isles, but also from France and America. As indicated in our issue of May 15, we attach special importance to the foundation of the James Watt chair of engineering, and we can imagine no better memorial to the great engineer than the creation of a school of research so endowed as to attract both a professor of exceptional ability and also the most brilliant students, of whatever class. Such a scheme would require an endowment on a scale altogether greater than that which is usually associated with chairs in universities, but it should be possible to raise the necessary money—especially with the sympathetic help of America, which of recent years has shown not only a ready appreciation of the value of scientific research, but also a generosity in its endowment which has been more admired than imitated in this country. It must always be remembered that the vital factor in research is the *man*, and every possible inducement should be offered to secure the best men, both as directors and students.

The commemoration ceremonies are to extend over the three days, September 16–18, and the official programme includes a garden-party at Watt's house (where his workshop can be seen in the state in which he left it in 1819), and visits to Soho Foundry and to two of his engines (one of which, the first pumping engine built for sale by Boulton and Watt in 1776, will be seen at work). A degree congregation is to be held by the University at which honorary degrees will be conferred on distinguished engineers and men of science.

The committee has issued a short pamphlet (by Prof. F. W. Burstall) in which an appreciation is given of the salient facts in the life of Watt, and of his epoch-making association with his colleagues Boulton and Murdock.

All who desire to attend the commemoration are asked to communicate not later than August 31 with the Hon. Sec., James Watt Centenary Committee, Chamber of Commerce, Birmingham.

ANDREW CARNEGIE.

MR. ANDREW CARNEGIE, the munificent benefactor of popular education in this country and in America, died on August 11, at Lenox, Massachusetts, in his eighty-fourth year. The son of a Chartist weaver in Dunfermline, Mr. Carnegie emigrated to the United States in 1848. From the humblest beginnings he rose during the Civil War to an important charge in the department of military transport and telegraphs. Then, by way of subserving his railroad and bridge-building plans, he created vast iron and steel works at Pittsburgh, carried on by means of a company the capital of which reached 25 millions, and which employed 40,000 men. He was bought out for some 50,000,000*l*. by the Steel Trust in the early 'nineties.

Mr. Carnegie thenceforward retired from business, and gave himself up to the wise disposal for public objects of his immense fortune. He was a convinced democrat; he proclaimed his conviction that "to die rich is to die disgraced"; and he consistently set himself to discover ways of applying his wealth for the uplifting of the people. In Pittsburgh he founded institutions for higher education, art and music, and popular culture, on a princely scale. To his native Dunfermline he gave libraries, parks, baths, and schools of hygiene and domestic science. For the Universities of Scotland he founded a Trust with a capital of two millions, the income, in equal shares, being assigned respectively to their better equipment in all modern subjects (he characteristically excluded classics, theology, and law), and to the payment of class-fees for all Scottish students of any faculty who asked for this help and were qualified to profit by it. The fund has provided not only for great extensions in the university staffs and buildings, but also for an endowment of advanced study and research in science, economics, modern languages, and history, which has largely transformed Scottish university activities. The well-meant fee-fund has doubtless been of great benefit to individual students, but as Scottish fees are not high, and never really deterrent, the direct effect in increasing the student population has not been striking. The indirect effect on the schools, due to the requirement that beneficiaries shall have completed a sound secondary education before entering the university, has been wholly advantageous.

Shortly before the war Mr. Carnegie established a United Kingdom Trust with an endowment of two millions, the income to be expended in providing public libraries, encouraging popular music, and generally in aiding or initiating schemes for the welfare of the "masses of the people." The Trustees took over the numerous promises pro-

visionally made by the founder as regards library buildings and church organs; but while they are fulfilling these they are starting on their own initiative inquiries and operations in other directions that are likely to bear good fruit. The elaborate investigations and reports they have subsidised and published on the library system, urban and rural, on plans for the physical well-being of mothers and children, on public play-centres and playgrounds, on municipal baths and wash-houses, etc., have been real contributions to knowledge. During this time of reconstruction a Trust that is thus accurately informed as to public needs, and able to aid in meeting them, is bound to render valuable service to the community. In this country already something like 700 Carnegie libraries, costing some 2½ millions, have been provided.

In the United States and Canada Mr. Carnegie's benefactions have been even more generous and more wide-reaching. Altogether they are more than 60,000,000*l*. One endowment provides pensions and retiring allowances for professors in approved American colleges and universities. Here again the indirect effect has been more important than the direct. To be "approved," an institution has to fulfil conditions as to government, efficiency, and standing laid down by the Trustees, with the result that many radical reforms in organisation have been induced, and a general raising of the educational standard has taken place. Another endowment—that of the Carnegie Institution of Washington—is professedly for the encouragement of scientific research in the widest sense of the term. Elaborate institutions in all parts of the United States, and for all branches of scientific inquiry, have grown up under its fosterage. Expeditions have been subsidised, equipment of a costly kind has been supplied for observatories, laboratories, and biological and other experimental stations, and also for individual workers everywhere who prove their competence to use it fruitfully. The Mount Wilson Observatory, of which Dr. G. E. Hale is director, is one of the most notable of these institutions. The grant to this observatory last year exceeded 30,000*l*., and the total amount expended upon the observatory since its foundation is more than 250,000*l*. There is also in New York a central Carnegie Trust, charged to assist the others as need arises, and generally to do for America what the United Kingdom Trust does for this country.

The difficulty of so applying his wealth as to avoid doing harm was always present to Mr. Carnegie's mind. Critics of his schemes did not let him forget it. In establishing here, and in other countries, Hero Funds for the recognition of individual deeds of self-sacrifice in the saving of life, and in founding a wealthy organisation for the express purpose of propagating peace and international goodwill, he thought that he had succeeded in safeguarding the principle of *nil nocere*. The war caused him to forgo some of his most cherished prepossessions, particularly as regards Germany and the ex-German Emperor, and the prospect of building up a world-wide peace based upon democratic solidarity. In spite of his hatred of warfare and the spirit associated with it, he came to see that only by the military victory of the Allies could the future of true civilisation be assured, and he willingly assented to a large grant from the Peace Fund for the relief of Belgian distress. In general, it may truly be said that Mr. Carnegie's ideas were based on sane visions of human progress, that he backed them lavishly, and that he enlisted the best men of his time in their working out. Their fruition, if it comes more tardily than in his eagerness he hoped, will come surely in some fashion, even if it be other than he pictured. He "builded better than he knew."

WALTER GOULD DAVIS.

MR. WALTER GOULD DAVIS, director of the Meteorological Bureau of Argentina for many years, died at his birthplace, Danville, Vermont, U.S.A., on April 30 in his sixty-eighth year. His early training was that of a civil engineer, especially in railroad surveying through the White Mountains. When in his early twenties, he went to Argentina as assistant to his uncle, Dr. B. A. Gould, founder of the Cordoba Astronomical Observatory. On the resignation of Dr. Gould in 1885, the National Meteorological Service, which was then a branch of the Cordoba Observatory, was reconstituted and Mr. Davis appointed director at the early age of thirty-four.

The organisation of such a service in a new country where voluntary observers are few was a matter calling for great energy, tact, and perseverance, but so successful was Mr. Davis in his efforts that by 1901 the seventeen meteorological stations to which he fell heir in 1885 had increased to eighty-eight, and 240 extra rainfall stations had been established. Thereafter the service developed with ever increasing rapidity, and on his retirement in 1915 there were forty-two stations of the first order, 152 of the second order, while rainfall was being observed at 1930 other places. The removal of the central office from Cordoba to Buenos Aires in 1901 enabled the long-cherished scheme of a daily weather map to be realised, and effective co-operation with other South American Republics resulted in the production of a daily weather map which covers 53° of latitude from Para, near the Equator, to Punta Arenas, in Magellan Strait. Mr. Davis established the hydrometric branch of his service in 1902 and was responsible for the dispatch of expeditions to investigate conditions in the Rio Parana, Paraguay and Pilcomayo, and other rivers in Matto Grosso and near the eastern Bolivian boundary. In 1904 he established a magnetic section with a central observatory at Pilar, near Cordoba, from which magnetic surveys of the whole country were organised in 1908 and 1912. In the latter year the systematic measurement of the level of the subterranean waters by means of gauges at twenty-three places was initiated. In February,

1904, Mr. Davis took over, on behalf of his service, from the *Scotia* Antarctic Expedition their sub-Antarctic station on Laurie Island, S. Orkneys, where an unbroken series of hourly meteorological and magnetical observations has since been maintained and upper air research undertaken.

The results of the labours of Mr. Davis are contained in thirteen large quarto volumes of the "Anales" of the Argentine Meteorological Office. Mr. Davis also wrote three works on the climate of the Republic, which appeared at intervals of about ten years from 1889 to 1910, and in 1914 he published his "History and Organisation," which gave a condensed summary of the work carried on during his thirty years of office. Whatever the changes of Government might be, Mr. Davis was always *persona grata* at Government House, and but for the economic crises that set in during 1912 his schemes for the setting up of a solar physics observatory in N.W. Argentina and the establishment of another Antarctic station on the west coast of Graham Land would have materialised. Mr. Davis at the time of his death was the oldest member of the International Meteorological Committee, to which he was elected in 1894. His last appearance at an international meeting was at Berlin in 1910, when he brought forward a recommendation for the introduction of a standard evaporimeter, the subject of evaporation being one to which he had always given great attention. He was elected an Honorary Fellow of the Royal Meteorological Society in 1898, and among other honours received many medals and diplomas from scientific institutions.

In official life, as in private life, he commanded the personal respect and admiration of all with whom he came in contact, and those who had the privilege to work under him could not help being impressed with his untiring industry and the calmness with which he invariably met the exasperating situations that so often arose in a land where the conduct of a large up-to-date scientific organisation is beset with many difficulties. R. C. M.

PROF. WILLIAM GILSON FARLOW.

Among the leading botanists of America the name of Prof. Farlow, whose death was announced in Nature for June 26, stood out, by seniority, by personal influence, and by scientific attainment. Prof. Farlow died on June 3 after an illness of three weeks. He was born in Boston, December 17, 1844, and graduated from Harvard College in the class of 1866, obtaining the degree of A.M. in 1869, and of M.D. in 1870. Doubtless he was one of those who followed the wise advice of Asa Gray: "Graduate in medicine; you never know how it will come in useful afterwards."

After graduation Farlow came to Europe and pursued his botanical studies in Strassburg. The old French Académie had been replaced shortly after the conclusion of the peace of 1871 by a German university, staffed by professors carefully selected for their eminence. De Bary, an Alsatian by birth, was the professor of botany. The study of fungi was a speciality of his laboratory, which was carried on in the cramped rooms of the old Académie. There no doubt the foundations were securely laid for that special study of fungi which Farlow pursued throughout his life. His most notable work at that time was, however, on the ferns; for he was the first to describe the direct origin of the sporophyte from the prothallus by vegetative outgrowth without the ordinary sexual fusion. This phenomenon of "apogamy," though familiar enough to all students now, was in 1874 the first notable digression from the regular alternation described by Hofmeister. Ten years elapsed before the observation of "apospory" by Druery. The discovery of these two cognate innovations has given a fresh impetus to inquiry into the nature of alternation, though alternation itself still remains an unsolved enigma.

After his return to America Farlow was for a time assistant to Prof. Asa Gray; but in 1874 he was appointed assistant professor in Harvard, and in 1879 he received the title of professor of cryptogamic botany, an appointment which he held for a period of forty years. His position became gradually stronger as years passed by, and there was probably among the botanists of America none whose opinion was held in greater esteem than his, while his published work touched a much wider circle than that in his own country.

In America Farlow was a pioneer in cryptogamic botany. His work was largely floristic and systematic. But experimental work was also conducted in his laboratory, and a school was founded, of which a brilliant example is seen in Prof. Roland Thaxter, the monographer of the Laboulbeniaceæ.

Personally Farlow was of small build, active, and most vivacious, with a constant ripple of quiet humour, a capital raconteur, and a charming host. In 1900 he married Miss Lilian Horsford. Together they made their house at Harvard, and their country home at Chocorua in the White Mountains of New Hampshire, places of happy memory to those who were fortunate enough to be their guests. Keenly alive to the duties and aspirations of the Allies, they both worked hard for the cause during the war.

Farlow was the recipient of many honours, being LL.D. of Harvard (1896), of Glasgow (1901), and of Wisconsin (1904), and Ph.D. of Upsala (1907). He was a member of the National Academy of Sciences and of the American Philosophical Society, and was president of the American Association for the Advancement of Science in 1906. He was Foreign Fellow of the Linnean Society of London (1892) and of the Academy of Sciences of Paris, as well as of many other scientific bodies in his own country and abroad. For the first twenty years of its existence he was co-editor of the *Annals of Botany*. Personally he was well known in this country by reason of repeated visits, and was heartily appreciated both for his social and his scientific qualities.

F. O. B.

NOTES.

PARTICULARS respecting the Government competition for the construction of aeroplanes and seaplanes on the lines of increased safety, to which allusion was made in NATURE of August 21, have now been published, and are obtainable from the Air Ministry. The following prizes are offered:—For aeroplanes of small type: First prize, 10,000*l.*; second prize, 4000*l.*; and third prize, 2000*l.* For large-type aeroplanes: First prize, 20,000*l.*; second prize, 8000*l.*; and third prize, 4000*l.* For seaplanes: First prize, 10,000*l.*; second prize, 4000*l.*; and third prize, 2000*l.* The latest date for entries is December 31 next. Sir H. H. Shephard has instituted a memorial to his son, the late Brig.-Gen. G. S. Shephard, in the shape of prizes for members of the Royal Air Force for essays relating to aviation. This year the prizes are to be awarded for essays on "Sea and Fleet Reconnaissance" and "Aerial Navigation and Pilotage." The administration of the annual competitions is to be carried out by the Air Council.

AN International Exhibition of Aeronautics is to be held in Paris from December 19 to January 4 next. There will be eleven groups of exhibits as follow:—Aerostatics; heavier-than-air apparatus; motors and propellers; sciences; art; structural materials; transport and shelters; cartography and bibliography; commerce; motor navigation; and various industries.

THE annual general meeting of the Institution of Mining Engineers will be held at the University, Birmingham, on September 10–12, when the following papers will be read, or taken as read:—"Report of the Committee on the Control of Atmospheric Conditions in Hot and Deep Mines"; "Training of Officers and Men of the Tunnelling Companies of the Royal Engineers in Mine-rescue Work on Active Service in France," G. F. F. Eagar; "A New Method of Working Thick Seams of Coal at Baggeridge Colliery," D. S. Newey; "Protractors," T. G. Bocking; and "Magnetic Meridian Observations: A Method of Utilising the Kew Observatory Records," T. G. Bocking. The following papers will be open for discussion:—"The Difficulties and Dangers of Mine-rescue Work on the Western Front, and Mining Operations carried out by Men wearing Rescue-apparatus," Lt.-Col. D. Dale Logan; "Accidents due to Structural Defects of Apparatus or Injury to Apparatus, and the Future of the Proto Apparatus," Lt.-Col. D. Dale Logan; "The Examination of Coal in Relation to Coal-washing," M. W. Blyth and L. T. O'Shea; and "The Education of Colliery Managers for Administrative and Social Responsibilities," W. Maurice.

THE seventh congress of the Spanish Association for the Advancement of the Sciences is to be held at Bilbao on September 7–12.

A SUMMER meeting of the Royal English Arboricultural Society is to be held at Bournemouth on September 16–18.

WE learn from the *Museums Journal* that it is proposed by the British Cotton Industry Research Association, Manchester, to establish a Cotton Industries Museum, having for its object the illustration of the production of cotton and its utilisation in industry.

WE much regret to have to announce the death on August 23, in his eighty-fifth year, of Dr. A. G. Vernon Harcourt, F.R.S., lately Lee's reader in chemistry at Christ Church, Oxford.

WE announce with regret the death on August 20, in his fiftieth year, of Dr. L. W. King, assistant keeper of Egyptian and Assyrian antiquities in the British Museum, and professor of Assyrian and Babylonian archæology in the University of London.

BY the death at the age of sixty-five of Sir W. H. St. John Hope has been lost one of the greatest authorities on British archæology the present generation has known. When in 1885 he was appointed assistant secretary of the Society of Antiquaries, a post which he held for twenty-five years, his life-work as an archæologist began. Soon after leaving Cambridge Sir W. St. John Hope took up the study of ecclesiastical architecture, monumental brasses, and heraldry, and he communicated numerous papers on these subjects to *Archaeologia,* the *Archaeological Journal,* and the Proceedings of local societies. His monograph on Fountains Abbey and those on the cathedral church and monastic buildings of Rochester are noteworthy examples of research and exposition. His chief work, however, was the description of Windsor Castle, undertaken under royal patronage, which was published in 1912. He was closely associated with the leading archæologists of his time, to whom his loss is irreparable, and he leaves no successor so well equipped in many fields of learning.

THE gold medal of the Hyderabad Archæological Society, which was instituted as a memorial to Sir A. Fleetwood Pinhey, the founder and first president of the society, has been awarded to Mr. H. Cousens for his work, "Bijapur and its Architectural Remains."

ACCORDING to *Science,* Mr. D. B. MacMillan, the leader of the Crocker Land Expedition, is to leave next summer on an exploring expedition to the Arctic regions, and will be provided with a small schooner, to be named the *Bowdoin,* with auxiliary power, built to withstand the pressure of ice-floes. The expedition party will probably number ten, and be absent for two or three years, engaged in work for the National Geographic Society.

AN expedition to Africa under the auspices of the Smithsonian Institution is in progress. Its main object is to supplement the collections of African animals and plants and ethnographical specimens already possessed by the U.S. National Museum, particularly the collections made by Col. Roosevelt. Although the museum has considerable collections from various parts of the West Coast of Africa, it is very deficient in specimens from the interior and South Africa, and these it is hoped to supply by the present expedition, which is under the leadership of Mr. E. Heller, and will be abroad for at least a year. It is proposed to utilise the kinematograph for taking pictures of the animals and primitive peoples met with.

THE report for 1918 on experiments on animals in Great Britain and Ireland has just been published (price 2*d.*). There is a marked increase over 1917 in the total number of experiments; this increase is due partly to the great development of Army hospitals and Army laboratories, and partly to the ever-growing demand that the whole study of national health and efficiency shall be advanced and maintained by all the resources of science. Twenty-three new places, mostly for Army work or for municipal work, were registered in 1918; and eight places, having served their purpose, were removed from the register. The vast majority of the experiments were inoculations, or of that class of experiments, made on behalf of Government

Departments and public health authorities, and for the preparation, testing, and standardising of sera, vaccines, and drugs. Much of this bacteriological and pharmaceutical work has been done by women; there was great need of their help, so many of the men being away on active service. In the administration of the Act relating to experiments on animals (39 & 40 Vic. c. 77) the Home Secretary is assisted by a permanent advisory body—Lord Moulton, Sir Anthony Bowlby, Sir John Rose Bradford, Sir Horatio Donkin, Sir Alfred Pearce Gould, Sir Seymour Sharkey, and Sir Charters Symonds.

A BRITISH munition dump exploded near Bailleul on August 8, causing the destruction of the recently built part of the town, and being, perhaps, responsible for the series of air-waves the effects of which were widely observed in the south-east of England on that day. Mr. R. B. Marston, writing to us from 160 Denmark Hill, S.E., noticed a sudden and prolonged shaking of an open window at about 1.10 p.m. G.M.T., followed after a minute or two by another and less pronounced shaking. At Caterham windows were shaken shortly after 1 p.m. At Norwich unfastened windows rattled violently at 1.10, 1.11½, 1.12, 1.12½, and again at 7.5 p.m.; and similar effects were observed at Wymondham, Attleborough, and other places in the neighbourhood. Bailleul is 11 miles south-west of Ypres, and about 135 miles from London and 140 miles from Norwich.

IN the *Museum Journal* (vol. ix., Nos. 3–4) for September–December, 1918, Mr. Theodoor De Booy gives an interesting account of explorations in Venezuela. He shows that the tribes known as Tucucus, Irapenos, Pariris, Macoas, Rio Negro and Rio Yasa Indians all belong to the great Motilone family, deriving their names from the rivers to the south of Machiques, the head-waters of which they frequent. Up to the present little has been known of the Motilones, who are to this day regarded with great dread by the Venezuelans, who are unwilling to penetrate into their forest retreats. Their nomadic habits are due to the fact that they are constantly at war with neighbouring tribes, but they received Mr. De Booy with great hospitality. They differ from the majority of South American aborigines in possessing a strong sense of humour, and they have attained a higher standard of culture than might have been expected, as is shown by his full account of their customs, arts, and industries.

DR. A. M. MEERWARTH, assistant curator of the Ethnographical Museum, Petrograd, has compiled for the Government of India a useful guide-book to the collections in the Indian Museum, Calcutta, of objects collected from the Andamanese, Nicobarese, and hill tribes of Assam. Though the museum contains much valuable material, this was collected only in a casual way, and there are many gaps in the series of the Mishmis, Manipuris, and Kukis, while those of the Nicobarese, Abor, Mikir, Khasi, and Garo are far from complete. It is a matter of regret that in the course of the Ethnographical Survey now in progress arrangements were not made to supplement the monographs by a representative collection of illustrative objects. Dr. Meerwarth gives lists of desiderata under the catalogue of each tribe, and now that attention has been directed to the matter the Indian Government should take active measures, before it is too late, to fill up the gaps in the museum collections.

DR. H. J. HANSEN has published, in Monograph xxxviii. (June, 1919) of the *Siboga* Expedition, a systematic account, with analytical keys to the species, of the rich collection made during the expedition of Decapod Crustacea belonging to the family Sergestidæ. Four genera are represented—Sergestes by eight species (three of which are new) Sicyonella by two species (one new), Acetes, and Lucifer. In his account of the hitherto imperfectly known genus Acetes, seven new species of which are described, the author has included descriptions and figures of other examples, chiefly from Indo-Chinese seas, not collected by the expedition. The *Siboga* gathered enormous quantities of sub-adult and adult specimens of the genus Lucifer, so that with these and the good collection at his disposal in the Zoological Museum in Copenhagen, the author has had ample material on which to carry out a revision of the genus. He concludes that of the twelve species previously described only three can be accepted as valid. Details of these three and descriptions of three new species are given.

IT is well known that the various species of Euglena are very sensitive to external influences, such as light, gravity, oxygen, and a supply of organic food material. *Euglena deses* is a sluggish form which is often found on the surface of mud containing a large percentage of organic matter, and Miss Rose Bracher has given in the *Annals of Botany* for January last, an excerpt from which has just been received, an account of the behaviour of this organism as it occurs on the mud along the banks of the River Avon within its tidal region. The Euglenæ are visible on the surface of the mud during the daytime as green patches, but they burrow under the surface during the night, or when placed at any time in the darkness. When covered by the tide they also disappear, but reappear again when the tide goes down if the light is strong enough. This tidal periodicity persists even when the organisms are removed from the tidal influence, for it was found that when placed in a dish in the laboratory they still continued to burrow into the mud at the time of high tide, and this power of response was maintained under these conditions for about three days.

THE Medical Research Committee has issued a report (Special Report Series, No. 34) by Dr. H. M. Vernon, with contributions from Dr. W. C. Sullivan, Capt. M. Greenwood, and N. B. Dreyer, on the influence of alcohol on manual work and neuromuscular co-ordination. Accuracy and speed in typewriting and in using an adding machine, and accuracy in hitting spots on a target, were used as tests, and both pure alcohol and alcohol in the form of wine and spirit were employed. There was no distinct difference between the two forms of alcohol, and when very dilute (5 per cent.) the effect was about three-fourths as great as when taken strong (37–40 per cent.) for the same amount of alcohol. Alcohol produced some effect in all individuals tested. The degree of effect depended largely on whether the alcohol was taken on an empty stomach or with food; on an average it was twice as toxic under the former condition. In the foodless experiments two subjects respectively made 88 per cent. and 156 per cent. more mistakes after consuming claret (19·4 c.c. of alcohol) and sherry (22 c.c. of alcohol). In the same subjects a similar amount of alcoholic liquid, taken with food, produced no measurable effect, but when the amount was increased to 35 c.c. of alcohol and more, deterioration in results obtained with the tests became apparent.

A STRONG plea for the establishment of a national institute of industrial biology was put forward by Mr. A. Chaston Chapman at a recent conference held under the auspices of the Society of Chemical Industry. There is very inadequate provision made in this country for systematic instruction in industrial

microbiology and for the study of the innumerable problems on which it bears. The first object of such an institute would be to provide for the systematic prosecution of research in connection with any industry in which micro-organisms or enzymes play an important part. Such industries—not to mention brewing and distilling—are, for example, the dairy industry, particularly cheese-making; the bread-making and pressed-yeast industry; tanning; lactic acid making; the treatment of sewage; wine- and vinegar-making, and agriculture generally. Another function would be the specialised training of teachers of microbiology and biochemistry, and the practical instruction of technical employees. A further object would be the provision of organisms in pure culture for use in industry and the housing of as complete a collection of technical micro-organisms as could be got together. No such collection exists in the United Kingdom; scientific and other workers in want of a particular organism are compelled to apply to their friends on the chance that someone may happen to have a specimen, or else must send abroad for it. Whilst much valuable work in microbiology is done in this country, the institutions are scattered and there is lack of co-ordination. Far better results would be obtained if the many closely related problems connected with the activity of micro-organisms and enzymes could be studied in a single institution, adequately provided with all the necessary appliances and specimens, where the various workers would have the opportunity of discussing their problems with one another.

IN a paper on the growth of crystals under controlled conditions (Journ. Washington Acad. Sci., vol. ix., p. 85, 1919), Mr. J. C. Hostetter shows how the faces developed on a crystal may result from a cessation of growth, incipient solution, and then renewed deposition of crystalline material. An octahedral crystal of alum may thus have its edges rounded by solution, and planes of the rhombic dodecahedron appear in place of these edges during renewed growth. These planes maintain themselves, and the original edge never becomes restored.

A COMMITTEE appointed by the council of the Institution of Electrical Engineers to consider the question of patent law amendment has recently presented a report to that body containing the outline of a scheme relating to a proposed Empire patent law; the intention of the scheme is that inventors shall, by means of a single application, be put in a position to secure a patent which shall possess validity in as many parts of the Empire, where patent protection receives recognition, as they may select in each particular case. Adhesion to this scheme should, it is suggested, be left optional to the various parts of the Empire, as also the decision on the question whether changes shall immediately be made in the existing patent laws having force therein. The undesirability of there being two classes of patents in force simultaneously in the same region is appreciated in the report, and it is, in consequence, suggested that the local Act or Ordinance, which it would be necessary to pass to give validity to the Empire patents in any particular region, should provide for such patents being treated in every respect as though they had been granted under the territorial patent law. It is proposed that the Empire patents should, in the first place, be issued in the same way as an English patent, the examination being made at, and the grant sealed in, the Patent Office in London. However, thereafter the Empire patents should, it is suggested, be assimilated with the domestic patents severally in each part of the Empire covered by the grant, questions of validity, infringement, revocation, etc., in relation thereto being dealt with and determined under the local patent laws. It is further recommended that the Empire patents should rest in each region on their own foundation—that is to say, any judgment given in an infringement or revocation action or like proceedings in the United Kingdom, or in any Dominion, etc., should alone operate in that part of the Empire in which the legal proceedings were taken giving rise to such judgment, and should in no way affect the patent in any other part of the Empire to which the grant extended.

READERS interested in the decimal system of weights and measures will remember that, in addition to his pioneer work in steam engineering, James Watt has another claim to the gratitude of posterity in having originated, towards the close of the eighteenth century, that demand for decimalisation and for co-ordination between the units of measure and weight which led in a few years to the conception of the metric system.

Symons's Meteorological Magazine for July shows the exceptionally dry character of the weather over England during the early part of June, and it was not until June 19 or 20 that the prevailing drought was brought to an end. In London the partial drought, which had lasted seven weeks, broke up on June 19, and was followed by cool and showery weather. The map giving the Thames Valley rainfall for June shows that the driest weather occurred in Hampshire and Sussex in the south, and in the central Midlands, where the total rainfall for the month was less than 1 in. At Tenterden, in Kent, the rain measurement was only 0·47 in., and at Hailsham 0·48 in. The August issue of the magazine gives an account of the transfer of the British Rainfall Organisation to the Meteorological Office. The rainfall work will, however, still be carried on at Camden Square by Mr. Salter, who, acting under the Meteorological Office, will be superintendent in charge of the rainfall work. As stated in NATURE of July 24 (p. 409), Dr. H. R. Mill has retired from the directorship of the British Rainfall Organisation and from the editorship of *Symons's Meteorological Magazine*. The Thames Valley rainfall map for July shows that the rainfall over the area was smallest in parts of Berkshire and Hampshire, where the total measurement for the month was less than 1·5 in.

THE *Monthly Meteorological Chart of East Indian Seas* for September contains, as usual, the winds and ocean currents and other meteorological information for the guidance of seamen, which are now of great value for airmen. At the back a chart is given showing the drift of ocean current-papers, issued under the authority of Mr. H. A. Hunt, Commonwealth Meteorologist. The tracks followed by the several bottle-papers are entered on the chart, and some details of each current-paper are given in a tabular form. Fifty bottle-papers are thus dealt with during the years 1908–14, and they show a general drift to the north-eastward from the Southern Indian Ocean towards South Australia and New Zealand. A current is also shown from Western Australia to North-East Africa. These drifts give the resultant direction in the special cases dealt with, but the rate of flow is, for various reasons, untrustworthy. The current-papers secured are only a small fraction of those thrown overboard. To obtain the fifty drifts, without doubt many hundreds of bottles would have been thrown overboard. Some captains make it a system to throw overboard at least one bottle a day. The tracks charted would be more valuable if the numbers of the drifts were given at start and finish, and if month and year were noted along the track.

IN the *Times* of August 15 there is an account of an excursion to the forests of Belgium under the guidance of M. H. Vendelmans, an expert in land reclamation. The historic forest of Soignes has not been seriously injured by the Germans, who were induced by M. Crahay, Director of Forests, to accept double the normal output, about 650,000 cubic ft. of timber in all annually. Promiscuous felling was thus avoided, and the forest retains its former aspect, to all appearances unimpaired. During the war some valuable researches were carried out by the Belgian foresters. The ravages of the fungus (*Peridermium strobi*) which had stopped the planting of the valuable white pine have been arrested by the spraying of the seedlings. Ash seed gathered early and sown immediately, *e.g.* on August 16, has been found to germinate freely in the following season, while seed gathered in October and sown in spring does not come up until the second year. This discovery of hastening the germination of ash, hawthorn, etc., which "lie over" ordinarily for a season, is not new, but has seldom been acted upon, as foresters feared that early gathered seed, being immature, would produce feeble seedlings. Worthless sandy tracks in the Campine are successfully afforested after preliminary cultivation, mainly with yellow lupine, which adds humus to the soil. Japanese larch and Sitka spruce have proved very successful in such soil, being as valuable species in Belgium as they are in England.

THE fundamental importance of a knowledge of the properties of the refractory materials used in high-temperature furnaces has been for some time recognised by the United States Government, and the Bureau of Standards has for the last two or three years been engaged in researches on the subject. The quartz or ganister bricks used for furnace work in the States are made mainly in Pennsylvania from crushed and ground quartzite rock. About 2·5 per cent. of lime is added, and the mixture moulded in steel moulds, dried and burnt in kilns at 2500°–3000° F. The best procedure to be followed in these processes, and the effects of variations of the procedure, are discussed in Technologic Paper No. 116 of the Bureau by Mr. D. W. Ross, and the effects of repeated burnings on the constitution and microstructure of the bricks by Messrs. H. Insley and A. A. Klein in No. 124. It appears that the quartz is converted on heating into cristobalite and tridymite, which are both of lower density. Unless this conversion is completed during the original burning, the resulting brick will expand on further heating, with serious results to the structures of which they form a part.

THE June issue of the Proceedings of the National Academy of Sciences of the United States contains a paper on the temperature of the human skin by Messrs. F. G. Benedict and W. R. Miles and Miss A. Johnson which throws a considerable amount of light on the conduction of heat from the interior of the human body to the skin. One of the most instructive of the observations made is that of the temperature of different points on the skin of a nude person exposed for 2⅔ hours to a temperature of 14·6° C. While the internal temperature remained 36·7° C., the temperature of the skin became high up on the chest 29·5°, at the nipple 22°, at the waist 30°, groin 24°, knee 22°, ankle 21°, shoulder 29°, and buttock 21°. A person clothed in the usual way has skin temperatures which differ from each other by 5° C. only, the chest and waist being hottest (34° C.), the buttock and calf coldest (29° C.). The skin temperatures were taken by means of a copper constantan couple in series with a string galvanometer giving a photographic record as the junction was moved slowly over the skin.

MESSRS. ILFORD, LTD., have recently introduced what they call "photographic vision" (or P.V.) colour-filters for use in connection with their various plates. Each transmits just that light to which the plate that it matches is sensitive, so that by looking at any object through either of them the colours of the object will appear of the same relative tone-values as they will be represented if photographed by the plate with which the filter corresponds. The improvement that will be effected by the use of colour-sensitive or panchromatic plates can thus be easily investigated. By adding to the "P.V." filter any colour-filter available for use in conjunction with the plate, the effect of photographing on the given plate and using the given colour-filter is seen at once, so that by trying one after another it is possible to find the colour-filter as well as the plate that will best give the desired result. The convenience of such a method of selecting plates and colour-filters is obvious, especially, perhaps, with artificially coloured objects, such as pictures and stained sections in photomicrography, though this method of trial must be of advantage in all photography except where pure black-and-white is concerned. An account of these with "micro-filters," other colour-filters, and the nature and use of their colour-sensitised, and especially panchromatic, plates will be found in a pamphlet entitled "Panchromatism" that has just been issued by Messrs. Ilford, Ltd. The pamphlet is illustrated with many examples that show the advantages of panchromatic plates in scientific, commercial, and pictorial photography, and gives technical details as to exposure and development that will very much facilitate the use of them and of the colour-filters.

A RECENT issue of the *Organiser* contains a special section dealing with industrial lighting. An article by Mr. Leon Gaster summarises the advantages of good illumination from the point of view of health, freedom from accidents, and efficiency of work, and quotations are made from the report of the Departmental Committee on Lighting in Factories and Workshops in order to indicate the main principles to be complied with. Artificial lighting is also dealt with in an article by Mr. H. C. Wheat on the lighting of machine-shops. The author attaches importance to the use of gas-filled lamps on the overhead system of lighting, and some effective illustrations of this method are shown. The modern tendency is strongly towards general lighting of this type, which leaves the room clear, enables lights to be well out of the range of vision, and permits rearrangement of machinery without the necessity of disturbing the lighting system. Mr. E. G. W. Souster deals with natural lighting in factories. It is not too much to say that the shape of a modern factory is determined mainly by access of daylight. Expenditure in this direction is fully justified, both by its direct influence on work and by the fact of its enabling an economy to be made in the use of artificial light.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, W.C.1, have sent us their July list of additions to their medical and scientific library during the months April–June. The catalogue is one that should be of interest and service to all readers of NATURE desirous of keeping abreast of scientific literature, giving, as it does, particulars of all important books dealing with the sciences published recently in this country and the United States. The list will be sent free to any address upon application.

OUR ASTRONOMICAL COLUMN.

KOPFF'S COMET 1906 IV. = 1919*a*.—Observations of this comet made at Nice and elsewhere early in the month have been published in the *Comptes rendus*, which show the correction of $-7'$ to M. Ebell's ephemeris already noted. This correction is included in the following positions of the comet:—

For Greenwich Midnight.

	R.A. h. m. s.	S. Decl. ° ′
August 29 ...	19 33 45	8 7·3
September 2 ...	19 36 38	8 4·5
6 ...	19 39 58	8 2·5
10 ...	19 43 42	8 0·8
14 ...	19 47 49	7 59·0

A NEW COMET.—A telegram received from Harvard through Paris, which is now the channel for astronomical information, states that a comet of the 8th magnitude was discovered in the constellation Pegasus by Mr. Metcalf on the night of August 20. A second message gives particulars of an observation made by M. Giacobini at Nice on August 22 at 11h. 45m., Paris time. The observed right ascension was then 22h. 46m. 49·5s., declination 28° 22′ 53″ N. Comparison of this with the approximate place given in the first message shows that the R.A. is decreasing 39s., and that the comet is going northward at the rate of 110′, per day. M. Giacobini considers the comet to be of 9th magnitude.

DISTRIBUTION OF GLOBULAR CLUSTERS AND SPIRAL NEBULÆ.—Dr. Harlow Shapley continues his ingenious researches into the structure of the universe in Contributions from the Mount Wilson Observatory Nos. 160 and 161. He here concerns himself largely with the distance of the clusters, and makes the point that if there is obscuring matter in the equatorial segment of our system which blocks out these clusters, all the clusters within a conical space should be so blocked out. But his diagram of the positions of these clusters drawn to scale shows that many of them are seen which are within this cone, so that the argument for the obscuring matter fails.

A PLANET BEYOND NEPTUNE.—Prof. W. H. Pickering points out (Harvard Circular, No. 215) that, according to measures of Harvard plates made by Prof. Russell, Neptune has recently begun to deviate from its computed position, as it would if perturbed by an unknown outer body, as shown by him in Harvard Annals (vol. lxi.) in 1909. The deviation is slight, being at present only 2″, and this, according to the investigation cited, was not expected until 1924. At its next opposition, December 30, 1919, this hypothetical planet should be located in R.A. 6h. 35m., dec. 23° N., and it is suggested that not only should search be made for this—though it will be difficult, for the place is in the Milky Way, where there are countless stars brighter than the object looked for—but rather that the position of Neptune should be observed as completely as possible.

PHOTOPHORESIS.

THE ratio of the surface area to the volume of a spherical body varies inversely as its radius. This fact led F. Ehrenhaft (*Ann. d. Phys.*, lvi., 81, 1918; cf. *Phys. Zeit.*, xv., 608, 1914; and xviii., 352, 1917) to use small spherical particles of various substances, produced either by volatilisation or by burning an electric arc between electrodes of the substance in an inert atmosphere, in his examination of the forces exerted by stationary light radiation on matter. Such particles, suspended in argon or nitrogen, were introduced into a small observation chamber, which was strongly illuminated from the side, the observations being made with a microscope placed perpendicular to the illuminating pencil of light. Ehrenhaft concentrated the light from an arc—with exclusion of the ultra-violet and infra-red rays—to a small conical pencil, with a diameter of only 1/10 mm. at its narrowest part. The behaviour of the small spherical particles in and near the region of most intense illumination was studied.

Outside the illuminating pencil all particles fall under gravity, but within it some travel in the direction of the light ("light-positive"), and others in the opposite ("light-negative") direction. To this phenomenon of the movement of material particles produced by light radiation Ehrenhaft has given the name "photophoresis." Particles of some substances (*e.g.* water) remain practically uninfluenced by the light; they are "light-neutral."

By the use of an electric field between the plates of the condenser in which a charged particle is observed, it can be kept suspended, and a second symmetrical illuminating system enables one to project light into the chamber from the opposite side. In this way, and with suitable light stops, long-continued observations of a single particle can be made.

The movement of any one particle is quite uniform in a homogeneous field of light; the force exerted on it is thus proportional to its velocity, and inversely proportional to its mobility. Since the velocity of the particle can be determined experimentally, and the mobility by use of the law of Stokes-Cunningham, it is a simple matter to calculate the force of photophoresis on the particle. In Ehrenhaft's experiments these forces were of the order of magnitude 10^{-11} to 10^{-8} dyne.

The force of photophoresis on particles of the same colour[1] and hence of the same size is independent of the pressure of the gas in which they are suspended, even when the mean free-path of the gas molecules is large compared with the size of the particles. Irene Parankiewicz (*Ann. d. Phys.*, lvii., 489, 1918) made observations on a single particle in an inert gas at different pressures, and found the force exerted on the particle to be independent of the pressure.

Particles of any one substance (*e.g.* selenium) of the same size attain different velocities in the gases hydrogen, nitrogen, and argon, but the photophoretical force $\left(=\frac{\text{velocity}}{\text{mobility}}\right)$ is found to be completely independent of the nature of the gas, though it increases with the intensity of the incident radiation. Photophoresis thus depends solely on the nature of the substance of which the particles are composed.

Of the elements so far examined, Na, K, Cu, Ag, Au, Mg, Zn, Cd, and Hg have been found to be light-positive, whilst Tl, Sn, Pb, P, Bi, S, and I are light-negative. The behaviour of the elements As, Sb, Se, and Te is noteworthy. When they are volatilised in pure, dry, inert gases, two kinds of particles result, one kind moving in the direction of the light and the other in the opposite direction. They are thus separable by light in exactly the same way as a mixture of light-negative sulphur and light-positive silver particles would be.

The photophoresis of light-negative selenium particles is constant and independent of time. Light-positive selenium particles are remarkable, however, in

[1] When the dimensions of the particle are less than the average wave-length of visible light, the natural colour of the substance examined is replaced by the colour of the light scattered by the particle. Particles of a blue colour are smaller than those of a colour corresponding with the less refrangible rays of the spectrum, and Ehrenhaft has been able to use the colour of such particles as a means of estimating their size.

that the force exerted on them appears to diminish with time. Now the electrical conductivity of grey, crystalline selenium, cooled suddenly from above 200° C., rises to a maximum and then steadily decreases with time. In the condition of maximum conductivity the selenium has pronounced metallic properties, and this suggests that the strongly light-positive selenium is of this kind, and becomes gradually transformed into a more stable and less light-positive modification as time proceeds. Tellurium appears to behave similarly.

In continuation of Arrhenius's work on comets' tails, Schwarzschild applied the theory of light pressure to objects of the order of magnitude of the wave-length of light, and showed that a scattering of the incident energy occurs on such particles. For any one kind of matter there is, as a consequence, a definite size of particle for which the ratio of the impressed force to the incident energy is a maximum. It is interesting to note that Ehrenhaft found a maximum velocity for particles of a substance of a particular size, the critical radius for silver (light-positive) being in accord with the demands of theory, viz. $9{\cdot}8 \, . \, 10^{-6}$ cm. But a maximum velocity exists also for light-negative particles, the critical radius being $26 \, . \, 10^{-6}$ cm. for sulphur and $15 \, . \, 10^{-6}$ cm. for light-negative selenium particles. In the interpretation of light-negative photophoresis, for which no theory at present exists, it must not be overlooked, however, that spherical particles, say, of sulphur or selenium are apparently attracted by the light, even when their dimensions correspond with several wave-lengths of light.

An interesting astronomical application of the phenomenon of photophoresis has been suggested by F. Zerner (*Phys. Zeit.*, xx., 93, 1919) to explain those anomalous comets' tails, which are directed towards the sun. He refers to the observations by I. Schmidt (Athens) of the 1882 comet, and suggests that whereas normal comets' tails may be composed of light-positive matter, it seems equally probable that anomalous comets' tails are made up of light-negative material. Ehrenhaft's laboratory separation of elements by photophoresis would thus seem to have an analogon in astronomy, and doubtless this point will form the subject of much interesting research in the future.

ROBERT W. LAWSON.

STANDARDS OF MASS.

A CIRCULAR recently issued by the United States Bureau of Standards[1] furnishes information concerning the verification of standards of mass and the most suitable forms of such standards for different purposes. An account is first given of the fundamental and national standards of mass of the United States. The standard is the kilogram, from which the pound is derived by the relation 1 lb. avoirdupois = 0·4535924277 kilogram, a relation which shows that the avoirdupois pound of the United States is the same as the British pound. The distinction between mass and weight is then considered, and it is explained that weight is measured in units of force, and that, as it is not feasible for the purposes of metrology to base the unit of force on some concrete standard force, the unit is derived from the established units of mass and acceleration.

The next section of the Circular is a convenient classification of weights, describing the forms recommended for particular classes of work. Weights intended to be of high precision, such as the primary standards of the various States of the Union or reference standards used by first-class manufacturers, are only accepted for verification at the Bureau if they comply with a certain specification as to material, form, and structure. Unless they are made of platinum or a metal which resists atmospheric corrosion, they must be protected by a plating of gold or platinum. Nickel-plating is not allowed. The material and plating must be such that no discoloration appears on the surface of the weights when they are placed in boiling water or when dried at a temperature of 110° C., as is done in preparing them for test. Manufacturers are advised that in machining such weights the knob, top, and sides should be finished first, next the outer rim of the bottom, and then the central portion of the bottom hollowed out by an amount approximately equal to the volume of the knob. The preliminary adjustment should be completed in the last operation.

As regards the adjustment of commercial test-weights, it is of great practical importance that the means of closing the adjusting hole shall be such that the weights can be readily readjusted, but that the operation shall necessarily involve the defacement of the stamp. Various forms of adjusting plugs suitable for such weights are illustrated and described.

The second half of the Circular is devoted to the verification of weights and the reduction of observations. The different methods of weighing are described and the particular purposes are indicated for which each method is most appropriately applicable. Illustrations are given of the various weighing forms in use at the Bureau, and examples of the methods of comparison, as well as of the computations, are set out in a very explicit manner. The important question of the correction for the buoyancy of the air is very fully treated. As regards the determination of humidity, it is pointed out that the hair hygrometer is almost the only form of instrument that can be used inside a closed balance-case. Such hygrometers should not be verified by placing them in saturated vapour, as this leaves them almost worthless for some time. Brief tables for use in the reduction of observations are appended, and the work is concluded by two very convenient tables giving the equivalents of avoirdupois pounds in kilograms, and *vice versa*, from 1 to 999 in each case.

In its present extended form this Circular is a typical example of the useful publications issued by the Bureau, the aim of which is not only to aid scientific investigation, but also to encourage and facilitate the employment of scientific methods in the commercial world.

[1] "Design and Test of Standards of Mass." Circular of the Bureau of Standards. No. 3, 3rd edition, pp. 89. (Washington, 1918.)

THE FOLK-SONGS OF THE TETON SIOUX.[1]

THE tribe of American Indians selected by Dr. Densmore for the researches now published is the Teton division of the Dakota Sioux tribe, to which the United States Government in 1868 assigned the portion of territory known as the Standing Rock Reservation, comprising some twenty million acres of the provinces of North and South Dakota. Strictly speaking, "Dakota" is the name applicable to the natives rather than to the region, and the largest division of the tribe or nation was known as Ti'toŋwaŋ, whence the contraction Teton.

The author, who had previously published two volumes on Chippewa music, has now transcribed, with the help of the phonograph, more than six

[1] "Teton Sioux Music." By Frances Densmore. Pp. xxviii+561+82 plates. Smithsonian Institution, Bureau of American Ethnology, Bulletin 61. (Washington: Government Printing Office, 1918.)

hundred songs, which are recorded and analysed in the present volume. It will thus be seen that the tribe possesses a very elaborate system of folk-songs, mostly associated each with a particular object, and it is to be noted with interest that, with the advent of civilising influences, phonographs have become much sought after by the Sioux themselves.

The distinctly tribal life of the Teton Sioux practically ceased with the suppression of the Sun Dance, the last of which was held in 1881, the final buffalo hunts occurring in the two following years. The sun dance was a most elaborate religious ceremony, in which the sun symbolised the Divine Power. It lasted several days, and, besides the complex ritual involved in the raising of the Sacred Pole and other observances, the leading feature was the self-infliction of bodily torture by the participants as a sacrifice to their deity. In the most severe forms this involved suspending the bodies of the willing victims by skewers and thongs driven through their flesh in the fierce heat of the sun until the victims tore themselves down, lacerating their flesh in the process. In addition, the whole of the assembly would go without food and drink for several days during this period. Each phase of the ritual had its special song. The natives even now deplore the substitution of the white man's religion and education for what they regarded as a discipline in heroism and bravery. It is stated that boys used to go through a miniature copy of the ritual in which they aspired to participate when of adult age.

Another group of songs is associated with certain societies existing in the tribe. Some of these, called Dream Societies, are constituted of individuals who are distinguished by the particular animals which appeared to them in dreams, such as the badger, buffalo, or elk; others were of a military character.

The only musical instrument which figures in most of these songs was the drum, which was of the usual type, but in the sun dance a stiff rawhide was also beaten. The author also refers very briefly to two whistles, one of bone used in the sun dance, the other of wood used in grass dances, which latter is capable of emitting a series of harmonics.

The tone-scale of the songs approximates to the well-known five-tone scale represented by the black keys of the piano, but the intervals are in reality a little different. A noticeable feature is a more or less marked resemblance to some of our present "modern" music, both in the absence of well-defined melody and in the irregularity of the rhythm. A few of the songs, indeed, do appear to possess something in the nature of a tune in them; in others the sequence of notes is very much of the same chaotic character that is so conspicuous at modern recitals. Again, in the rhythm one bar is often in three-time and the next in four—an artifice which Brahms knew how to use with good effect, but which is now commonly employed in order to render music unlovely, and therefore what is described as "thrilling." Again, the voice part is frequently independent of the drum rhythm, the latter being usually in more regular time. It might thus be possible that if suitable harmonics, or rather discords, were added, these songs might appeal to the class of present-day concert-goers who appreciate the attempts of modern pianists to represent "Le Raid des Zéppelins."

What, however, is much more important is the glimpse which this unique collection affords of the highly complex system of primitive poetic and musical art that this tribe of American Indians had built up, which is fast becoming obsolete under the social and educational influences brought into force by the white races.

G. H. BRYAN.

ELECTRICAL PURIFICATION OF CLAYS.

THE phenomena known as electrical endosmose and cataphoresis, whereby matter in a very finely divided or colloidal state is capable of being influenced by an electrical potential, have been extensively investigated. For instance, when a colloidal solution of arsenious sulphide is placed in a cell and a direct current at a potential of 100 volts passed from suitable electrodes through the solution, the colloidal particles tend after a time to collect round the positive pole, leaving a clear zone round the negative pole.

It is found that nearly all substances, if in a sufficiently fine state of division, are attracted either to one pole or the other. It has also been observed that aggregates of certain fine particles can be dispersed and separated by adding to the fluid in which they are suspended minute quantities of alkali in the case of those particles attracted to the positive pole, and of acid to those which are attracted to the negative pole. Moreover, if the particles are not sufficiently susceptible to the dispersive effect of the added electrolyte, they can be made so by being allowed to adsorb some colloid, such as colloidal silicic acid.

This latter discovery has a most important bearing on the clay industry. China clay and ball clay are examples of such aggregates of fine particles, and if a thick slip is made up of the clay and water the addition of small amounts of alkali causes the clay particles to disperse, and the slip, as a consequence, to become much thinner and more mobile, the clay particles remaining in suspension a considerable time and exhibiting vigorous Brownian movement. On passing a current of electricity through such a suspension, the clay particles collect and adhere closely to the anode plate, the water collecting in a zone, substantially free from clay, round the cathode. Impurities in the original clay, such as mica, quartz, felspar, and iron compounds, are either unaffected by the electrical potential and settle out, or attracted to the cathode. A means of purifying clay on a commercial scale can thus be evolved from a consideration of the above phenomena, as was shown by the exhibit of raw and purified clays of the Osmosis Co., Ltd., at the recent British Scientific Products Exhibition.

The commercial equipment for such a process consists of a blunger, settling tanks to allow the coarse impurities to settle out of the suspension, and an Osmosis machine composed of a rectangular trough in which is arranged horizontally a cylindrical metal anode surrounded beneath the surface of the slip and at a short distance away from it by a cathode through which, by paddles or other means of circulation, the clay slip is driven. The cylinder is made to revolve slowly, and by means of a scraper the dried purified clay, containing 20–30 per cent. of water, is collected.

The machine not merely collects the suspended clay and frees it from water, but subjects the suspension to an electrical purification as well, for should there still be in suspension with the clay minute particles of mica, iron, and silica that have not had time to settle out in the tank, these are not attracted to the anode, but for the most part remain in the effluent leaving the trough. Consequently, electrically osmosed clay is a purer product than can be obtained by any method of settling or centrifuging.

The improvements effected by the process are:—(1) Pyritic and other forms of uncombined iron are removed. (2) The sintering temperature of the clay is lowered so that a lower kiln-temperature can be employed, with consequent saving of fuel. (3) Clay can be graded into different degrees of fineness.

(4) Fireclays can be rendered more plastic and more refractory by this treatment.

Another very important application of cataphoresis is the electrical filter-press. In this press the electrical potential is utilised as a means of driving out the water from suspensions of fine particles; thus, instead of needing pressures running up to 20 atmospheres in some cases where ordinary filtration is used, a head of 14 ft. is ample for the purpose in the electrical filter-press. As an instance of the efficiency and speed with which filtering can be accomplished by such a press, a cake of china clay 4½ in. thick containing 25 per cent. of water can be made in less than two hours.

The applications of electrical endosmose or electrical dialysis in various industries is of importance. Gelatine can be freed from all inorganic mineral matter, so that an ashless gelatine can be obtained of a purity which should be suitable for photographic purposes. There is clear experimental evidence that pure colloidal silicic acid can be prepared from sodium silicate and alumina from sodium aluminate by subjecting their solutions to an electrical potential in cells with suitable diaphragms through which the alkali can migrate. These are a few examples of useful developments, but it is evident that an increasing number of important commercial processes may be expected to arise out of the application of the principles underlying the above phenomena.

EVOLUTION IN POTATO-BEETLES.[1]

DR. W. L. TOWER has continued his attack on the "evolution problem" by a further study of Chrysomelid beetles of the genus Leptinotarsa. He first gives an account of the material as it occurs in natural conditions; he then describes the emergence of new attributes and qualities, discovering the relation of these to old characters and their interaction when brought into combination or into competition with existing characters; and, thirdly, he has experimented in Nature, chiefly in the Arizona deserts, with the new forms to see how newly arisen characters, or their combination into specific forms, behave as they meet the conditions of the environment into which they are thrust by the processes of their origination. His most general result is the demonstration that the methods of evolution are heterogeneous, even in these beetles, but "the basis of all methods of change is found to be directly the product of the nature of the genetic factors of composition and their capacity for diverse modes of reaction, especially with factors of the environing complex. Purpose, utility, and kindred concepts have found no support, every change appearing as the chance mechanistic product of the reacting agents; while the product of the reaction either was able or not able to operate under the conditions of origination, so that survival is decided at once, and not after long and faltering trials."

The characters of organisms are usefully grouped under three chief categories:—(1) The *specific properties* or *qualities* which cannot be altered without change in the identity of the kind; (2) *attributes* belonging to and distinguishing members of the same species or kind from one another; and (3) *conditions* or "states of being or activity which can be changed or removed without altering the identity of the body or its kind in any way." The central problem of evolution is the origin of diversity or heterogeneity, and Dr. Tower distinguishes two main possibilities: "first, transmutation in the qualities with subsequent adjustments in the attributes and conditions of organisms; and, second, diversity resulting from recombinations (metathesis)." The gametic constitution or hereditary make-up of the organism consists of a number of factors (neither "carriers" of anything, nor fixed units, nor necessarily substances, but agents or centres of activity which make certain results possible) and of a number of determiners which settle which of several possible reactions will come off. "In Nature there is constant and unlimited mixing of these factors and determiners in all kinds of combinations; but out of this complex of interacting agencies certain definite patterns always come, so that the net result is a rather stable population as far as the patterns presented in any given location. The heterogeneity presented, however, is not one of quantity nor of directions of departure, but is at least analogous to the diversity found in many chemical operations where nearly related compounds are easily transmuted into some other through the presence or absence of something whose presence determines a different configuration of the system, and whose absence permits of another and diverse arrangement." The pattern on the beetle's pronotum is, in its way, an intricate system, and the presence of certain form-determiners decides the type. Thus, if we generalise from the beetles, variation is not so much the origin of something distinctively new as a shuffling of the pre-existing cards. It is recombination or metathesis. "The phenomena must be viewed as purely physical in character and of chance occurrence, dependent upon chance gametic agents, combinations, and conditions present, as far as their appearance and frequency in Nature are concerned." But the system in question (or any analogous set of characters), "although complex and the product of many interacting agents, nevertheless acts as a unit in many reactions, passing through the operations of reproduction and crossing in its entirety, or at other times emerging from the reactions changed in relations and arrangements of the elemental simplest characters, indicating altered relations between the conditioning agents." But when the further question is asked how the populations of beetles in different locations have become different, Dr. Tower confesses his inability to give any answer. "I have most earnestly, in this investigation, in numerous instances made effort to certainly discover the productive agents of conditions found in Nature . . . but in no instance thus far have I been able to attain to the desired end of a proof of the actual cause of the conditions observed."

We have not found the memoir very easy to read (and our quotations will in part show why). We think that the author might have focused more clearly the new conclusions he has arrived at. But the volume is the outcome of laborious investigations and careful critical analysis; it is a fine example of the modern transition from plausible speculations to the verifiable experiments. We are not so sure as the author is that science is shut up to mechanistic formulation; and we should like to know how he comes to be so sure that his beetles have no purposes. We notice a few misprints like "Cuèrrot," but they have, no doubt, arisen mechanically.

[1] "The Mechanism of Evolution in Leptinotarsa." By William Lawrence Tower. (Publication No. 263.) Pp. 340+19 pls.+156 figs. (Carnegie Institution of Washington, 1918.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MME. CURIE has been appointed professor of radiology in the Warsaw University.

A SCHOLARSHIP of the value of 1200 rupees has been given to the Madras Medical College by Lt.-Col. W. D. Smith for the benefit of students in chemistry and drugs.

CAPT. F. DOWNIE, of the South Wales School of Mines, has been appointed head of the new electrical engineering department of Rutherford Technical College, Newcastle-upon-Tyne.

DR. J. K. WOOD, principal assistant in the chemistry department of University College, Dundee, has been appointed lecturer in physical chemistry at the Manchester Municipal College of Technology.

A DEPARTMENT of Italian studies has been established in the University of Manchester, and Dr. E. G. Gardner, of the University of London, has been appointed to the newly instituted chair of Italian.

AN Agricultural History Society has been established in Washington, having for its object the stimulation of interest, the promotion of study, and the facilitation of publication of researches in agricultural history. The president is Dr. R. H. True, and the secretary-treasurer Mr. L. Carrier, both of the Bureau of Plant Industry, Washington.

THE new prospectus of the Merchant Venturers' Technical College, which provides and maintains the faculty of engineering of the University of Bristol, has been received. We note that the courses include schemes of study for persons intending to engage in civil, mechanical, electrical, or automobile engineering. These schemes comprise not only the usual engineering subjects, but also instruction in French and German for scientific purposes, as well as in book-keeping, accountancy, works administration and organisation, commercial law, and estimating and writing specifications.

AN interesting and useful piece of work has been inaugurated by the Staffordshire Education Committee, viz. the placing of an exhibit in flower-shows throughout the county embodying the life-histories of some of the most troublesome insect pests which infest gardens and orchards; a prepared collection of potato diseases which are prevalent in the county, with instructions how to control them; varieties of potatoes grown on the county demonstration plots, all of which varieties are resistant to black scab or wart disease; early varieties of culinary and dessert apples; samples of bottled fruit and vegetables, fowl and rabbit; bees, with model hives and full complement of apparatus; and diagrams and charts demonstrating the best methods of planting, pruning, and training fruit-trees. Pamphlets on the subjects are also distributed. An expert pruner and propagator of fruit-trees is to be appointed for the purpose of furthering fruit-growing in the county.

THE London County Council has issued its "Handbook of Classes and Lectures for Teachers" for the session 1919–20. The lectures are available to all teachers actually employed in teaching within the administrative County of London, irrespective of the particular institution at which they may be engaged. Teachers employed in teaching elsewhere than within the administrative county may be admitted where accommodation permits. Among the courses of lectures in science the following may be mentioned:—Five lectures on practical astronomy for schools, by Prof. T. Percy Nunn, at the London Day Training College, on Wednesdays at 6 p.m., beginning on September 24; ten lectures on the history of the development of fundamental principles of physics, by Prof. Bragg and Mr. Orson Wood, at University College, on Tuesdays at 5.30 p.m., beginning on March 16, 1920; ten lectures on modern views of electricity and matter, by Prof. O. W. Richardson, at King's College, on Saturdays at 10.30 a.m., beginning on October 4. There will also be courses of lectures on experimental psychology, the experimental study of children, psycho-analysis, and psychological problems in special schools. Copies of the handbook can be obtained on application to the Education Officer, L.C.C. Education Offices, Victoria Embankment, W.C.2.

AN interesting address delivered at Manchester to the newly formed Association for the Scientific Development of Industry by Mr. E. C. Reed, of London, on "Education for Genius," has been published in pamphlet form (The Abbey Press, Westminster, 31 pp., price 6*d*.). Mr. Reed propounds the theory that it is possible, given the necessary facilities, to educate for genius, and thereby increase largely the world's supply of geniuses in every department of productive life. It is argued that by developing natural aptitude, by training and deepening the intuitive and allied faculties of the superconscious mind, the supply of genius can be much enlarged. Talent is defined by the author as labour *plus* aptitude, and genius as labour *plus* natural aptitude *plus* intuition, and the latter, it is contended, can equally be made the subject of training. But this is surely to beg the whole question. Speaking of the genius which produces great art, Ruskin truly and forcibly says in "Modern Painters" that every system of teaching is false which holds forth "great art" as in any wise to be taught to students. Great art is precisely that which never was, and never will be, taught; it is pre-eminently and finally the expression of the spirits of great men. And in his "Joy for Ever" he further remarks:—"You have always to find your artist (your man of genius), not to make him; you can't manufacture him, any more than you can manufacture gold. You can find him and refine him; you dig him out as he lies nugget-fashion in the mountain stream; you bring him home, and you make him into current coin or household plate, but not one grain of him can you originally produce." That "genius must frequently waste its years and dissipate its efforts in trying to make headway against an indifferent or hostile atmosphere" may be freely admitted, and it must therefore be the business of the nation to create for its nurture a sympathetic and appreciative environment, "in which all phases," as the author of the address observes, "of intellectual and cultural activity, mechanical, literary, æsthetic, are each highly developed and equally honoured." The address is well worthy of thoughtful study.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 4.—M. Léon Guignard in the chair.—G. **Humbert**: The formation of a fundamental domain of an automorph group.—P. **Marchal**: The evolutive cycle of the woolly Aphis of the apple-tree (*Eriosoma lanigera*). It has been proved that in America the American elm harbours the sexual generation of American blight, whilst the apple and some other trees of the same group act as intermediate hosts. In Europe the cycle would appear to be different; the sexual generation does not occur, and the species is continued during the winter by hibernation on the apple-tree, the reproduction being parthenogenetic.—E. **Ariès**: The density of the saturated vapour of propyl acetate and the density of the liquid emitting this vapour.—A. **Denjoy**: Riemannian integration.—N. E. **Nörlund**: The polynomials of Euler.—R. **Garnier**: The irregular singularities of linear differential equations.—E. **Kogbetliantz**: The integral of Angelesco.—C. **Trémont**: New methods for the mechanical testing of metals. Description and diagrams of two simple pieces of

apparatus for measuring the tensile strength and resistance to shock of metal test-pieces of very small dimensions.—E. **Esclangon**: The mechanical transformation of sidereal time into mean time. Calculations of simple gears show that with four wheels having 119, 330, 317, and 314 teeth the conversion can be made with the loss of only one second in eight years; with wheels having 188, 465, 563, and 227 teeth the error can be reduced to one second in 249 years.—P. **Roubertie** and A. **Nemirovsky**: Some new fluorescent screens for use in radioscopy. As a substitute for platinocyanides in radioscopic screens, cadmium tungstate has given good results. This material forms screens which are stable in air, and unaffected by prolonged exposure to X-rays. —R. **Levaillant** and L. J. **Simon**: The action of chlorosulphonic acid on methyl sulphate. The preparation of methyl chlorosulphonate.—G. **Mignonac**: The synthesis of ketimines by the catalytic method. A mixture of ammonia and the vapour of a ketone passed over thoria at 300°–400° gives a ketimine of the type R.C(NH).R′. The method fails with fatty ketones, condensation products of the ketimines being produced. The preparation and properties of methylphenyl-, ethylphenyl-, *cyclo*hexyl-, and diphenylketimines are described.—L. **Daniel** and M. **Thoulet**: Shell deposits in the neighbourhood of Erquy (Côtes-du-Nord).—H. **Coupin**: The absorption of mineral salts by the root-tip. The root-tip can absorb mineral salts in solution, and these are freely utilised by the growing plant.—P. **Vayssière**: Some methods for the destruction of crickets and their application. Trials were made of flame projectors, poison gas, and arsenical pastes, and all of these can be used with success under certain conditions. Sprays of chloropicrin (50 per cent.) can be used where a flame is inadvisable, and arsenical pastes in places where there are no animals at pasture. Special organisations under direct State control will be necessary if these measures are to be carried out effectively.—H. **Violle**: The peroxydases in milk. The peroxydase reaction cannot be used to judge the quality of a milk; normal milk from a healthy cow may contain very little peroxydase, whilst milk from a diseased udder may contain peroxydase in quantity.—W. **Kopaczevski** and A. **Vahram**: The suppression of anaphylactic shock. The injection of solutions of sodium oleate, sodium taurocholate, sodium glycocholate, or of saponin five minutes before the second injection of serum completely suppresses the anaphylactic shock in guinea-pigs.—J. **Amar**: The elastic force of diseased lungs.—V. **Galippe**: New researches on the presence of living organisms in the cells of the male genital glands (microbiosis, normal or accidental parasitism).

August 11.—M. Léon Guignard in the chair.—A. **Lacroix**: A scapolite from the Madagascar pegmatites, constituting a precious stone.—G. **Bigourdan**: The observatory of the Mazarin College. —M. **Portevin**: Certain defective fractures of test pieces taken across the steel bar.—A. **Cornu-Thénard**: Tests of flexure by shock on notched bars.—A. **Schaumasse**: Observations of the periodic Kopff comet made with the bent equatorial at Nice Observatory. Positions for August 4, 6, and 7 are given, together with positions of the comparison stars. On August 4 the comet was of the 10th magnitude, the nebulosity being about 3′, showing a diffuse central condensation.—J. **Guillaume**: Observation of the periodic Kopff comet (1919*a*) made with the bent equatorial at Lyons Observatory. Position given for August 7. —D. **Faucher**: Contribution to the study of the lacustrial levels and fluviatile levels of the lower valley of the Vardar.—F. R **du Caillaud**: The Baixo da Judia.—M. **Marti**: A measurement of the velocity of sound-waves in sea-water. Direct-measurements in Cherbourg harbour gave the velocity of sound in sea-water at 14·5° C. (density 1·024) as 1503·5 metres per second, a figure notably higher than those obtained by other experimenters.—H. **Abraham** and E. **Bloch**: The application of amplifiers to the mechanical recording of wireless telegraphy signals. —G. **Chavanne** and L. J. **Simon**: The composition of some Asiatic petrols. The method of critical solution temperatures in aniline described in earlier communications has been applied to various fractions of petrol arising from Persian, Sumatran, and Borneo petroleums.—P. **Bonnet**: The relations between the Otoceras layers of Armenia and those of the Himalayas. The Armenian Otoceras-bearing strata have been usually considered as being older than the Himalayan deposits. Fresh observations are given controverting this view, and tending to prove that the strata are of the same age.—L. **Gentil**: The origin and morphological characters of the *rideaux* in chalk districts.—J. **Rouch**: The diurnal variation of the wind velocity in the atmosphere. Tabulation of the results of a series of experiments with balloons.—G. **Guilbert**: The scientific prediction of the weather. —L. **Blaringhem**: The heredity of the facies of *Capsella viguieri*.—A. **Guilliermond**: The chondriome and the ergastoplasmic formations of the embryonic sac of the Liliaceæ.—F. **Vlès**: Remarks on the absorption spectra of the hæmoglobins from Annelids. The spectra of the hæmoglobins of certain invertebrates and those of mammals present small, but distinct, differences.—L. **Vialleton**: The epiphyses and cartilage of conjugation of the Sauropsidæ.

SYDNEY.

Linnean Society of New South Wales, May 28.—Mr. J. J. Fletcher, president, in the chair.—Dr. R. J. **Tillyard**: A fossil insect wing belonging to the new order Paramecoptera, ancestral to the Trichoptera and Lepidoptera, from the Upper Coal Measures of Newcastle, New South Wales. This wing, which is perfect except for a small piece missing at the apex and a very small area of the base covered over by rock, was discovered in February, 1919, by Mr. John Mitchell at Belmont, N.S.W., and is named *Belmontia mitchelli*, n.g. et sp. It is clearly related to both the Mecoptera and Protomecoptera, but is definitely of the type found in the most archaic Lepidoptera and Trichoptera, though with a greater number of branches to both the radial sector (seven) and the media (five). The posterior arculus is remarkably well developed, and is shown to be a true branch of M, which should be denoted by M_5. The wing can be easily restored, the only points in doubt being the shape of the jugal lobe and the position of vein 3A. In discussing its affinities the author compares it very fully with the forewing of the genus Rhyacophila, and shows that the latter is derivable from it in every single detail by reduction. The same is true of the Micropterygidæ within the order Lepidoptera. Reasons are also given why the Megaloptera and Planipennia may also, very probably, be derived from this type of wing; but its relationships with the Diptera are doubtful, and with the Mecoptera they are definitely *collateral*, not ancestral. The wing shows that at least two Holometabolous orders were present in Upper Permian times, the Mecoptera having been already discovered in the same locality.—Prof. T. H. **Johnston** and O. W. **Tiegs**: Pseudobonellia, a new Echiuroid genus from the Great Barrier Reef. The outstanding features of the animal are:—(1) The Bonellia-like form of the body of the female; (2) the presence of two uteri; (3) numerous simple anal glands opening directly into

the rectum instead of into anal vesicles; (4) the ovary is restricted to the extreme posterior end, and is transversely situated; (5) presence of a well-defined siphon associated with the anterior part of the intestine, with which it communicates by means of a greatly folded region; (6) the presence of a distinct invagination of the body-wall between uterine openings (in this invagination, which the authors call the male tube or andrœcium, a tiny degenerate male is lodged); (7) though the female possesses from two to four ventral hooks, the male is devoid of them; (8) the presence of two vesiculæ seminales; and (9) the partial fusion of the male with the female, its posterior end being more or less enveloped by the tissues of the andrœcium, so that there is a very pronounced parasitism. The differences between the species under review and those belonging to other genera of Echiuroidea have led the authors to propose a new genus, Pseudobonellia (*P. biuterina*, n.sp.), for this remarkable worm. Various stages in parasitism in sex relationship are referred to in the paper. —Dr. R. J. **Tillyard**: Mesozoic insects of Queensland. Part v. Mecoptera, the new order Paratrichoptera, and additions to the Planipennia. This part deals with six specimens, of which four are named. A new family, genus, and species of Mecoptera are described from the Upper Trias of Ipswich, having a six-branched media, but with the first cubitus cut off short in a peculiar manner. Two very fine wings from the same horizon belong to Trichopterous-like insects, but have certain important differences in the venation, viz. the anal veins primitive and separate and the first cubitus without any apical fork. Together with the two allied genera already described, these are removed to a new order Paratrichoptera. In the Planipennia the same horizon yields a portion of a fine wing closely resembling that of the recent *Megapsychops illidgei*; this is placed in a new genus within the family Prohemerobiidæ. The recent Psychopsidæ are shown to be the direct descendants of these. Some interesting evidence is forthcoming as to the nature of the vein called by Comstock the "posterior arculus," which is shown almost certainly to be a true posterior dichotomic branch of M, and should, therefore, merit the notation M5.

Royal Society of New South Wales, July 2.—Prof. C. E. Fawsitt, president, in the chair.—Miss Marguerite **Henry**: Some Australian fresh-water Copepoda and Ostracoda. The present paper arose out of an investigation of the transmission of worm-nodules in cattle. In this investigation it was necessary to examine all the Crustacea that might have acted as intermediate hosts. Besides material collected at Kendall, where the work was principally carried on, some was collected at Lett River, Blue Mountains, Waterfall, Botany, Dorrigo, Byron Bay, Casino, Bangalow, Orange, Cumbalum, and Corowa. Amongst the sixteen species collected, four were found to be new.—Rev. W. W. **Watts**: Some notes on *Neurosoria pteroides*. Results of an investigation into the structure and systematic position of a very rare fern from tropical Queensland. It was first published by Robert Brown as an Acrostichum, but Mettenius had created for it the new genus Neurosoria. The paper reviewed the work of previous students, and submitted careful notes of an independent examination of the material available in Australia.—J. H. **Maiden**: Notes on Eucalyptus, No. vii., with descriptions of new species. Four species are proposed as new, viz. the "Morrel" of the eastern goldfields of Western Australia, which has hitherto been looked upon as a large-growing form of the red mallee (*Eucalyptus oleosa*); a narrow-leaved mallee from Comet Vale, in the same State; a tree from Bathurst Island, Northern Territory; and a mallee-like species from the summit of the Barren Mountain, Bellinger-Clarence district. Discovery of *E. bakeri* in Queensland, together with additional notes of a technical character in regard to other eucalypts occurring in some of the other States.

BOOKS RECEIVED.

The Occlusion of Gases by Metals: A General Discussion held by the Faraday Society, November, 1918. (Reprinted from the Transactions of the Faraday Society, vol. xiv., parts 2 and 3, 1919.) Pp. 93. (London: The Faraday Society, n.d.) 8*s.* 6*d.*

Fevers in the Tropics. By Sir Leonard Rogers. Third edition. (Oxford Medical Publications.) Pp. xii+404. (London: Henry Frowde and Hodder and Stoughton, 1919.) 30*s.* net.

Menders of the Maimed: The Anatomical and Physiological Principles Underlying the Treatment of Injuries to Muscles, Nerves, Bones, and Joints. By Prof. A. Keith. (Oxford Medical Publications.) Pp. xii+335. (London: Henry Frowde and Hodder and Stoughton, 1919.) 16*s.* net.

Fossil Plants: A Text-book for Students of Botany and Geology. By Prof. A. C. Seward. Vol. iv.: Ginkgoales, Coniferales, Gnetales. Pp. xvi+543. (Cambridge: At the University Press, 1919.) 1*l.* 1*s.* net.

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